Biodiesel Co-Firing—Field Demonstration Results

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PRODUCT DESCRIPTION

Biodiesel is a renewable fuel produced through the transesterification process. The fuel is typically produced from soybean oil and is used in diesel engines as a diesel alternative/supplement. Due to potential emission and greenhouse gas benefits, New York Power Authority (NYPA) and EPRI conducted full-scale tests of biodiesel / #6 oil blends at NYPA's Charles Poletti Station, Unit #6 boiler.

Results & Findings

The biodiesel co-firing test program was highly successful, and no issues regarding operability and performance were experienced. All emissions were either reduced, or at a minimum, did not experience an increase. Flame stability was slightly improved.

Challenges & Objective(s)

The primary objective of the project was to demonstrate up to 20 percent biodiesel co-firing with residual fuel oil on a large-scale power-producing boiler. Tests were conducted to monitor combustion stability, boiler emissions, and measurement of boiler and fuel system performance.

Applications, Values & Use

Based on test results, other oil-fired power-producing boilers may consider biodiesel co-firing as a means of meeting emissions goals (including CO_2), using biodiesel / #6 oil blends for generating renewable power and lessening reliance on foreign fuel. Economic considerations and future regulations will, of course, play a key role in this decision process.

EPRI Perspective

This demonstration represented the first-of-a-kind deployment of biodiesel co-firing with residual oil in a large-scale power-producing application. The demonstration was highly successful, and no issues regarding operability and performance were experienced at biodiesel blend ratios up to 20 percent. All emissions were either reduced, or at a minimum, did not experience an increase.

Approach

Modifications required for storage, blending, and mixing of biodiesel with #6 oil were designed and implemented, and key issues addressed. A test plan was developed, and the demonstration executed over a two-day period. The project team first ran tests with the base #6 fuel oil to document baseline performance. Various blends of biodiesel fuel were then tested to determine changes in boiler performance and combustion stability at two different loads ("partial" and "full"). A description of these tests and results is documented in this report. All pertinent data were recorded by an independent contractor as well as the plant's PI system.

Keywords
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CONTENTS

LIST OF FIGURES

1
INTRODUCTION

1.1 Background

Biodiesel is a renewable fuel produced through the transesterification process. The fuel is most prevalently produced from soybean oil and is used in diesel engines as a diesel alternative/supplement. Due to the potential to realize significant emission and greenhouse gas benefits, as well as to reduce dependence on foreign oil, the New York Power Authority (NYPA) and EPRI conducted full scale tests of biodiesel / #6 oil blends at New York Power Authority's (NYPA) Charles Poletti Station, Unit #6 boiler. The primary objectives of these tests were to monitor combustion stability, boiler emissions, and measure boiler and fuel system performance. Tests were first run with the base number 6 fuel oil to document baseline performance. Various blends of biodiesel fuel were then tested to determine changes in boiler performance, emissions, and combustion stability at 2 different loads ("partial" and "full"). A description of these tests and results obtained are documented in this report.

1.2 Biodiesel Fuel

Fuel for the tests was purchased through a competitive solicitation. NYPA's Fuels group issued a competitive solicitation for 120,000 gallons of biodiesel. A technical specification for the fuel was provided which defined the quality standard, delivery schedule, quality assurance and testing procedures to be used to verify compliance with the specification.

1.3 System Performance

Full scale testing of the biodiesel co-firing system occurred in October of 2006, and results are documented in Section 3 of this report. Tests were conducted at both a reduced load (400 MW net) and at the unit's full load of 865 MW (net). In summary, the system was successful in maintaining or reducing all targeted emissions levels. No operability issues were experienced, and combustion performance was maintained or even slightly improved. Publically available data was used to complete an analysis of life cycle CO_2 emissions reductions through the use of biodiesel co-firing. The analysis concluded that a significant reduction in CO_2 emissions could be realized through the use of biodiesel fuel to displace heavy oil firing.

1.4 New York Power Authority's Charles Poletti Station

The Charles Poletti Power Project, located in Astoria, New York is a steam-electric power plant operated by the New York Power Authority (NYPA). The unit utilizes a Foster Wheeler front wall-fired boiler rated for maximum continuous output of 865 MW firing natural gas and/or number 6 low sulfur fuel oil and is designed to provide 6.6 million pounds of steam per hour at 1,005°F (541°C). The unit is regularly used for load requirements between 18% and 100% of full load (150 to 865 MW). Thirty-six burners are fired from the front wall and are configured in a six by six array. The firing system is equipped with twelve overfire air (OFA) ports placed in two rows of six ports each above the burners. The bottom row of OFA ports is closed off with refractory as a result of a study conducted with EPRI as a NOx reduction too. Two division walls span the height of the boiler and divide the radiant section into thirds. Flue gas recirculation is utilized through the use of air dilution fans that draw flue gas downstream of the economizer and mix it with forced draft air at the bottom of the furnace prior to entering the windbox. To facilitate testing, a temporary biodiesel storage and feed system was installed in the Poletti Fuel Oil Yard to inject biodiesel fuel into the number six (6) oil fuel forwarding pump suction header.

2
PROJECT OBJECTIVES AND SYSTEM DESIGN

2.1 Program Objectives

The objective of this work scope was the full scale demonstration of biodiesel co-firing at the New York Power Authority Charles Poletti #6 boiler. This objective represented the first time that biodiesel fuel was co-fired in a large scale power producing boiler. During the demonstration, an assessment of the emissions and boiler performance impacts of burning various biodiesel/ #6 oil blends was conducted. These tests were conducted consistent with minimal risk on plant operations and boiler performance.

Towards meeting these objectives, the following tasks were performed.

2.1.1 Design and Installation of the Biodiesel Co-Firing System

Although the Poletti combustion and burner system was not modified, the fuel oil storage and transport system needed to be adapted to accept the blended fuel. An assessment was conducted of the pre-existing Poletti fuel storage and handling system, and modifications required for adequate storage, blending, and mixing of the biodiesel with the #6 oil were designed and implemented. The principal issues that needed to be addressed included:

1. development of a mixing procedure for the use of selected blends of #6 fuel oil and biodiesel fuel;
2. evaluation of procedures, practices and anticipated changes to plant operations;
3. analysis of the biodiesel co-firing system design and operation;
4. analysis of the blended biodiesel / #6 oil fuel properties and characteristics;
5. development and qualification of a blended fuels testing procedure;
6. specification of the biodiesel and blends fuel properties.

The biodiesel injection and metering control system was designed by NYPA using their in-house engineering group. The final detailed design was comprised of an inline blending system, which was designed by MEGRANT Corporation and Fitzsimmons Systems whom where selected through a competitive bid solicitation.

A temporary biodiesel storage and feed system was installed in the Poletti fuel oil yard. The biodiesel storage and injection system was composed of the following major components.

1. 2 x 20,000 gallon storage tanks, double wall design, UL Listed and NFPA Approved.
2. Fill station and fill piping to offload 7,000 gallon tanker trucks.
3. Submersible fuel pump(s) and associated manual control valves.
4. Fuel meter.
5. Welded connection to fuel line and “hot tap” of fuel forwarding pump suction header.

3
TEST PROTOCOL AND INSTRUMENTATION

3.1 Test Plan Development

A test plan was set up to demonstrate biodiesel co-firing at two loads with five different fuels/fuel blends. A set of baseline tests were first conducted to document the performance of the boiler at conditions when burning pure #6 fuel oil. Tests were then conducted with biodiesel blend ratios at 5%, 10%, 15%, and 20% biodiesel mixtures. For the full load test, a second baseline test was conducted following completion of the 20% biodiesel test, to ensure consistency with initial baseline settings. In addition, at high load, “low O_2” cases were run at both baseline (zero biodiesel) and 20% biodiesel to assess the ability of the biodiesel blend to operate at low O_2 levels (and accordingly, reduce NOx emissions) vs. the baseline fuel. Combustion stability, emissions, boiler performance and fuel system performance were monitored during each set of tests to gauge the success before proceeding to the next level of biodiesel fuel mixture.

Each test was conducted at as close to identical combustion conditions as practical. The following combustion settings were set to perform consistent tests to the best extent possible for each of the two loads tested:

- Burners Out of Service
- Overfire Air Port Setting
- Dilution Air Fan Setting
- Burner Air Register settings
- Atomizing Steam Pressure
- Excess O_2

Following the achievement of steady state, test conditions were held for 15 minutes prior to data acquisition. Information acquired for each test included fuel oil samples, boiler performance data, emissions data, flame observations, and furnace exit temperatures, as detailed below and documented in Section 4 of this report.

3.2 Fuel Samples

Two fuel samples were taken for each test conducted. Fuel was collected by NYPA from a source just upstream of the burner fuel distribution system for subsequent analysis The fuel samples were stored in one-gallon containers with a label specifying the time, date and test number.

3.3 Boiler Performance Data Collection

Boiler performance data was collected from the Plant Information (PI) data acquisition system. Data was collected at 5-minute intervals during the duration of each test. A list of the collected data is itemized in Appendix A.

3.4 Emissions Data

O_2, NOx, CO, SOx, PM10 and opacity measurements were collected throughout the test. Flue gas was drawn from the stack and measured according to the below specified methods by TRC, an independent test contractor.

Flue Gas Constituent	Measurement Method
O_2 (dry)	EPA REFERENCE METHOD 3A
NOx	EPA REFERENCE METHOD 7E
CO	EPA REFERENCE METHOD 10
SO_2	EPA REFERENCE METHOD 6C
Opacity	EPA REFERENCE METHOD 9
Particulate Matter Exhaust Gas Flow Rate Stack Temperature Moisture Concentration	EPA Methods 1, 2, 4, 5 and 202

3.4.1 Instrumental Methods for NOx, CO, SO_2, O_2, CO_2 and THC Emissions

Emissions tests were conducted to determine emissions of NOx CO and SO_2. Testing was performed in accordance with EPA Methods 7E, 10 and 6C respectively. In addition, diluent concentrations of oxygen (O_2) and carbon dioxide (CO_2) were measured in accordance with EPA Method 3A. Triplicate 60-minute tests were performed. A schematic of the measurement system is presented in Figure 3-1.

Methods 3A, 7E, 10 and 6C are continuous instrumental methods and data was recorded by a 'Strata' data logger programmed to calculate 1-minute and 60-minute averages. The measurement system was housed in the mobile laboratory located in close proximity to the sampling location.

3.4.1.1 Gas Sampling System

The primary components of the gas sampling system are a glass fiber thimble filter, stainless steel probe, 100 feet of heated (250°F ±25°F [121°C ± -4°C]) Teflon sampling hose moisture condenser system, 300 feet of unheated Teflon hose, a leak-free Teflon diaphragm pump and a stainless steel gas manifold with an atmospheric bypass rotameter. The analyzers draw sample gas from the manifold.

3.4.1.2 NOx Analyzer

A Thermo-Electron Corporation (TECO) Model 42H Chemiluminescent NO/NOx analyzer was used to determine NOx concentrations. The chemiluminescent reaction of NO and O_3 (ozone) provides the basis for the analytical method ($NO + O_3 \rightarrow NO_2 + O_2$ + light). A photomultiplier-electrometer-amplifier produces a current proportional to the NO concentration. The output of the amplifier provides a signal for direct readout on a meter indicator or for outputs to a recorder or computer.

3.4.1.3 SO_2 Analyzer

A Western Research model 721M microprocessor controlled fluorescent analyzer was used to measure SO_2. The instrument operates on the principle of fluorescence, by excitation of sulfur dioxide molecules by pulsing high intensity ultraviolet (UV) light. The resulting fluorescence is measured by a photo multiplier tube (PMT) sensitive in the near UV. The signal generated is an analog voltage linearly proportional to the sulfur dioxide concentration in the gas stream.

3.4.1.4 CO Analyzer

A TECO Model 48H non-dispersive infrared gas analyzer was used to measure CO concentrations. The technique of GFC offers improved specificity and sensitivity over conventional non-dispersive infrared (NDIR) techniques. GFC spectroscopy is based upon comparison of the detailed structure of the infrared absorption spectrum of the measured gas to that of other gases also present in the sample being analyzed. The technique is implemented by using a high concentration sample of the measured gas, i.e., CO, as a filter for the infrared (IR) radiation transmitted through the analyzer.

EPA Method 10 calls for the gas sample to pass through an ascarite scrubber to remove CO_2 as to not to interfere with CO detection. However, the TECO CO analyzer is designed so CO_2 does not interfere with the detection of CO.

3.4.1.5 O_2 Analyzer

A Servomex O_2 analyzer was used to determine the concentration of O_2 in the stack gas. This instrument uses the paramagnetic principle, whereby the magnetic susceptibility of the gas volume is measured by the force acting on a nonmagnetic test body suspended in a magnetic field. The force is converted to an output current proportional to the O_2 concentration.

3.4.1.6 CO_2 Analyzer

A Servomex infrared CO_2 analyzer was used to monitor CO_2 emissions. This instrument operates on the principle of CO_2 having a known characteristic absorption spectra in the infrared range. Radiation absorbed by CO_2 in the sample cell produces a capacitance change in the detector which is proportional to the CO_2 concentration.

3.4.1.7 Calibrations

Multi-point analyzer calibrations (zero, mid, and span) were performed each day, prior to testing, to demonstrate the linearity of each analyzer in accordance with the EPA Methods. The gas concentrations used for the multi-point calibrations were 0%, 40-60%, and 100% of each analyzer's range. System calibrations (zero and span gas introduced to the system through a tee at the back of the probe) were performed at the beginning and end of each test period. Calibration gases were certified according to EPA Protocol 1 procedure. Instrument ranges and calibration gas concentrations are outlined below.

Analyzer	Range	Zero	Low Gas	Mid Gas	High Gas
NO_x	0-450.5 ppm	Nitrogen	NA	184.8 ppm	450.5 ppm
SO_2	0-454.9 ppm	Nitrogen	NA	207.2 ppm	454.9 ppm
CO low	0-297.91 ppm	Nitrogen	NA	181.21 ppm	297.91 ppm
O_2 CO_2	0-22.3% 0-18.15%	Nitrogen Nitrogen	NA NA	10.2% 10.1%	22.3% 18.15%

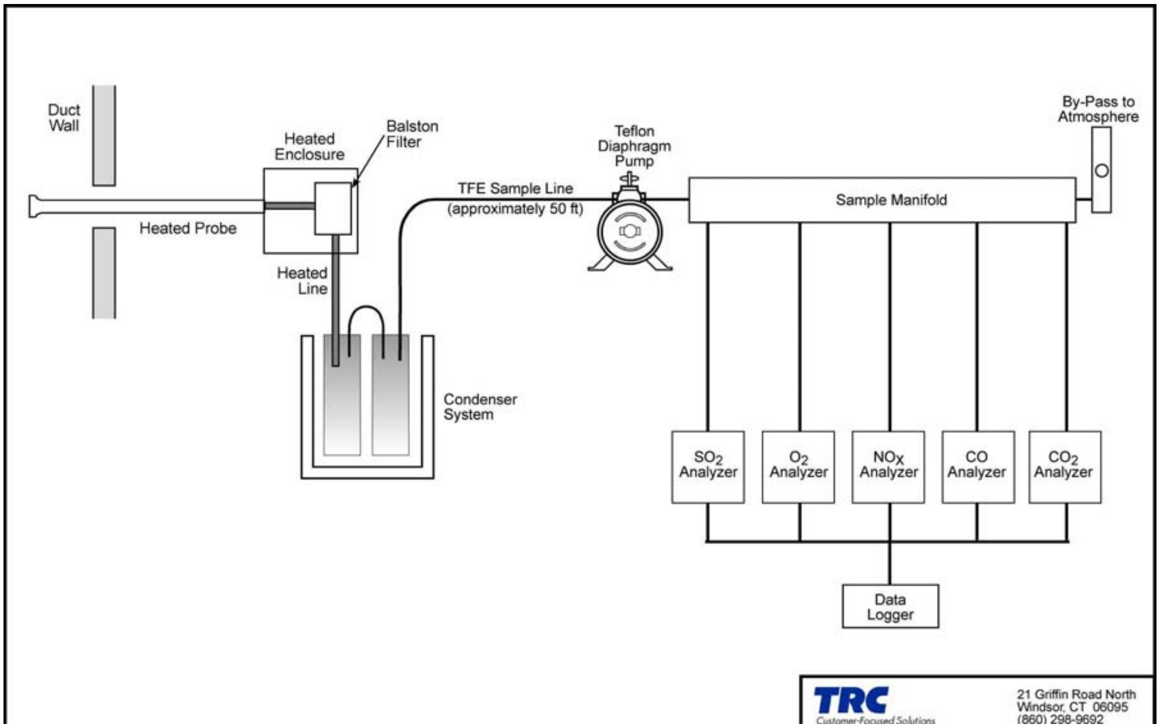

Figure 3-1
EPA Method 3A, 6C, 7E, and 10 Continuous Monitoring System

3.4.2 Opacity Observations

Opacity observations were conducted in accordance with EPA Method 9 using a certified opacity reader. Observations were conducted approximately every fifteen seconds for a 12-minute period during each test condition. A total of nine 12-minutes visible emission observations were conducted and data are presented in Appendix A.

3.4.3 PM-10 Measurements – EPA Methods 201A and 202

Sampling for PM-10 was conducted in accordance with EPA Methods 201A, Constant Sampling Rate Procedure, and 202. One 60-minute test was conducted per test condition.

Sample Collection. The sampling train was a modification of an EPA Method 5 consisting of a PM-10 cyclone pre-cutter and nozzle, an in-stack filter, a heated probe, four impingers, a dry gas meter, and an orifice flow meter. The cyclone pre-cutter, meeting the design criteria of Method 201A, was attached to the end of a standard EPA Method 5 sampling probe. An ice bath containing four impingers was attached to the back of the sampling probe. The first three impingers contained 200 milliliters of HPLC grade deionized water and the fourth impinger contained approximately 200 grams of silica gel. The weight of the impinger train was measured to the nearest 0.1 gram before and after sampling to determine moisture gain. Flexible tubing, a vacuum gauge, needle valve, leakless vacuum pump, bypass valve, dry gas meter, calibrated orifice, and an inclined water manometer completed the sampling train. A preliminary flow traverse was conducted prior to sampling to determine the differential pressure (dP) at each sampling point to determine the appropriate nozzle size and sampling rate. The sampling rate corresponded to a range of stack flowrates to produce 100% (+/- 20%) isokinetic sampling. Before each test run, the sampling train was leak checked and the leak check was considered acceptable if the leak rate was less than 0.02 cubic feet per minute. A post-test leak check was conducted after removing the PM-10 cyclone from the probe.

Sample Recovery. The probe assembly and cyclone were taken to a clean wind free area where the train was disassembled and the following sample fractions were recovered:

Container No. 1: The filter was removed and placed into clean petri dish, sealed, and labeled.

Container No. 2: The cyclone exit turnaround cup, the inner surfaces of the exit tube, the probe liner and front half of the filter holder were rinsed in triplicate with acetone. The rinses were deposited into a clean 250-milliliter sample jar. The sample jar was sealed and labeled.

Container No. 3: The contents of the first three impingers were deposited into a clean sample bottle. The impingers and connecting glassware, including the probe liner, were rinsed in triplicate with methylene chloride. The rinses were deposited into a clean 250-milliliter sample jar. The sample jar was sealed and labeled.

<u>Sample Analysis</u>. Each sample fraction was analyzed as follows:

Container No. 1: The filter was desiccated for at least 24 hours and weighed to a constant weight to determine PM-10 mass reported to the nearest 0.1 milligram.

Container No. 2: The acetone rinses were evaporated and weighed to constant weight. The rinses were reported to the nearest 0.1 milligram.

Container No. 3 The impinger contents and rinses were extracted with methylene chloride and separated using a separatory funnel to determine organic and inorganic fractions. Each fraction was transferred to a tared Teflon bag and evaporated to dryness at ambient temperature and pressure. The results were reported to the nearest 0.1 mg.

A computer program developed by TRC was used to calculate the mass emission rates in grains per dry standard cubic foot and pounds per hour. The program also calculated the stack moisture (%), molecular weight of the stack gas, and the percent isokinetics.

3.5 Furnace Exit Gas Temperature

Furnace exist gas temperature was measured at each test condition for evaluation of furnace combustion and furnace heat transfer (reference Figure 3-2, right). A 15 foot inconel Type ‘K’ thermocouple was inserted into a 10 foot long by 5/8” diameter inconel sheath. The thermocouple probe was inserted approximately 10 feet into the furnace box. One temperature measurement was recorded for each test condition in units of Fahrenheit.

3.6 Flame Observations

Flames were observed for flame stability, along with any other noticeable changes from baseline (e.g., zero biodiesel) conditions. In order to assess flame conditions, a Lenox hand held Diagnostic Fireside Cart System was used (reference Figure 3-2, left).

Figure 3-2
Hand Held Flame Diagnostics System (left) and Furnace Exit Temperature Probe (right)

3.7 Windbox Oxygen Concentration

For the purpose of quantifying flue gas recirculation (FGR) to control NOx, oxygen concentration measurements were conducted at the windbox location with a portable electrochemical cell analyzer (TSI, Inc. – Model CA-CALC, test method 030). The system is a complete stand-alone measurement device that includes a probe, sintered metal particulate filter, moisture trap, sample pump, electrochemical cells, and data logger.

Measurements were recorded using the CA-CALC internal data logger and data was downloaded to an electronic spreadsheet after each test. Calibration data was also downloaded and analyzed at the end of each test to verify test validity on site.

3.8 Control Room Testing Instrumentation

NYPA's Poletti power plant is equipped with a WDPF Distributed Control System. The system is linked to a Plant Information (PI) data server where thousands of data points are collected. Data was collected from Poletti's PI database to document pertinent plant performance data. This performance data is included in Appendix A.

4 TEST RESULTS

Testing of the biodiesel / #6 oil co-firing system was accomplished in October 2006. Tabulated results summarizing tests undertaken are given in Appendix A. It should be noted that the data points given in this summary represent the average of the individual data points recorded as specified in the previous discussion of Test Procedures. A total of 14 tests were recorded (5 at approximately 400 MW net, 9 at approximately 750 MW net). In addition, it should be noted that the percentage of biodiesel used in the test nomenclature (e.g., 5%, 10%, 15%, and 20%) was based on the biodiesel metering system described earlier in this report. These percentages proved to be fairly consistent with calculations made from the analysis of the blended samples.

The biodiesel co-firing test program was highly successful, and no issues regarding operability and performance were experienced. Of particular interest are the following.

4.1 Impact of Biodiesel Co-Firing on Operability and Performance

No impacts on unit operability were experienced at any of the blend ratios tested. Based on a qualitative assessment of the flame during the 400 MW test with the Lenox hand held Diagnostic Fireside Cart System, the flame stability appeared to be slightly improved as greater percentages of biodiesel were utilized. At full load, the magnitude of the fireball made any assessment difficult.

With respect to furnace efficiency, it was noted that the furnace exit gas temperature (FEGT) was slightly reduced as the biodiesel blend was increased, indicating a slight increase in furnace heat absorption. This is consistent with the decrease in plant heat rate as recorded by the plant PI system (reference Appendix A) and shown in Figure 4-1 (reduced load) and Figure 4-2 (full load).

A plan was developed prior to testing and followed to reduce the fuel oil temperature that was delivered to the burners. This was done to maintain the design operating viscosity of the fuel oil delivered to the burners. Fuel oil temperature was reduced as biodiesel blend ratio was increased to accommodate the lower viscosity blended fuel. No issues were identified with this plan. It was observed that as biodiesel blend ratio was increased, fuel forwarding pump Amps were reduced. Additionally, steam required by the fuel oil heaters to maintain fuel oil temperature was reduced as a result of the lower fuel oil temperature setpoint.

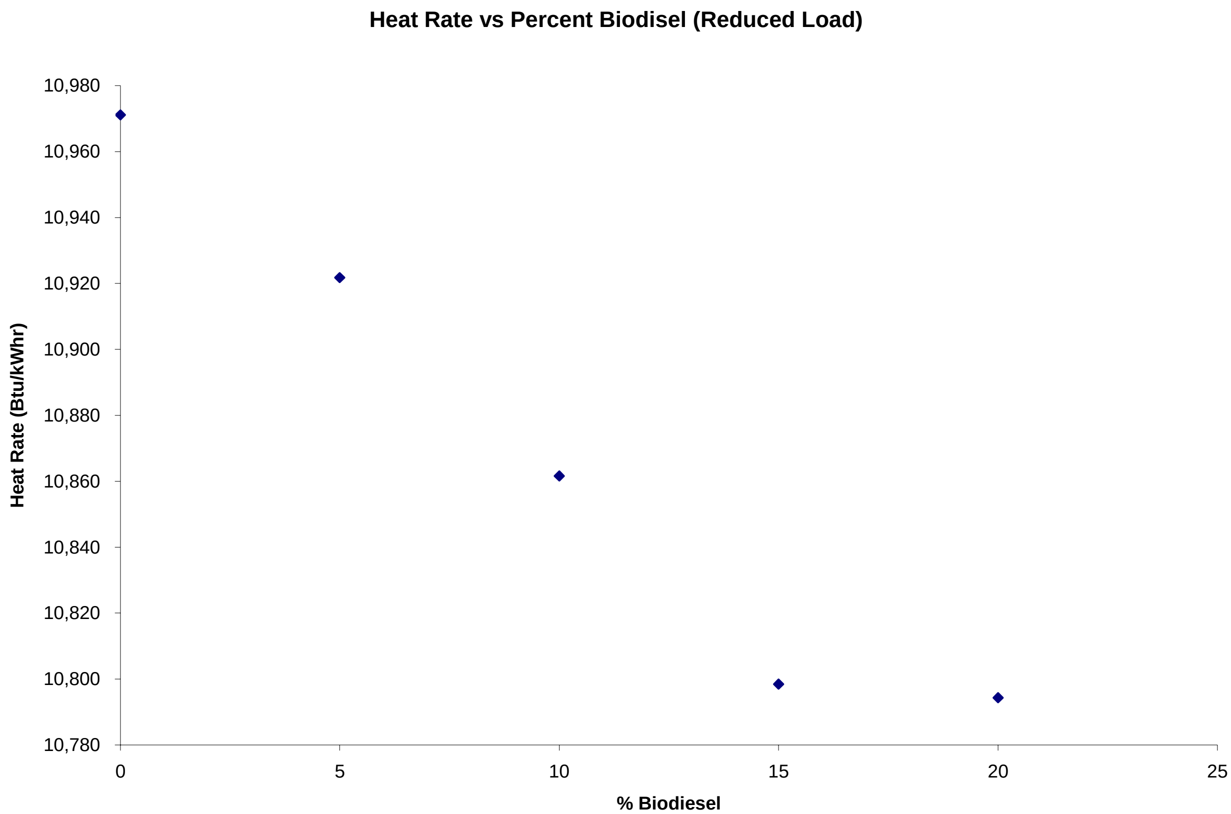

Figure 4-1
Plant Heat Rate vs. Percent Biodiesel in Blend at Reduced Load

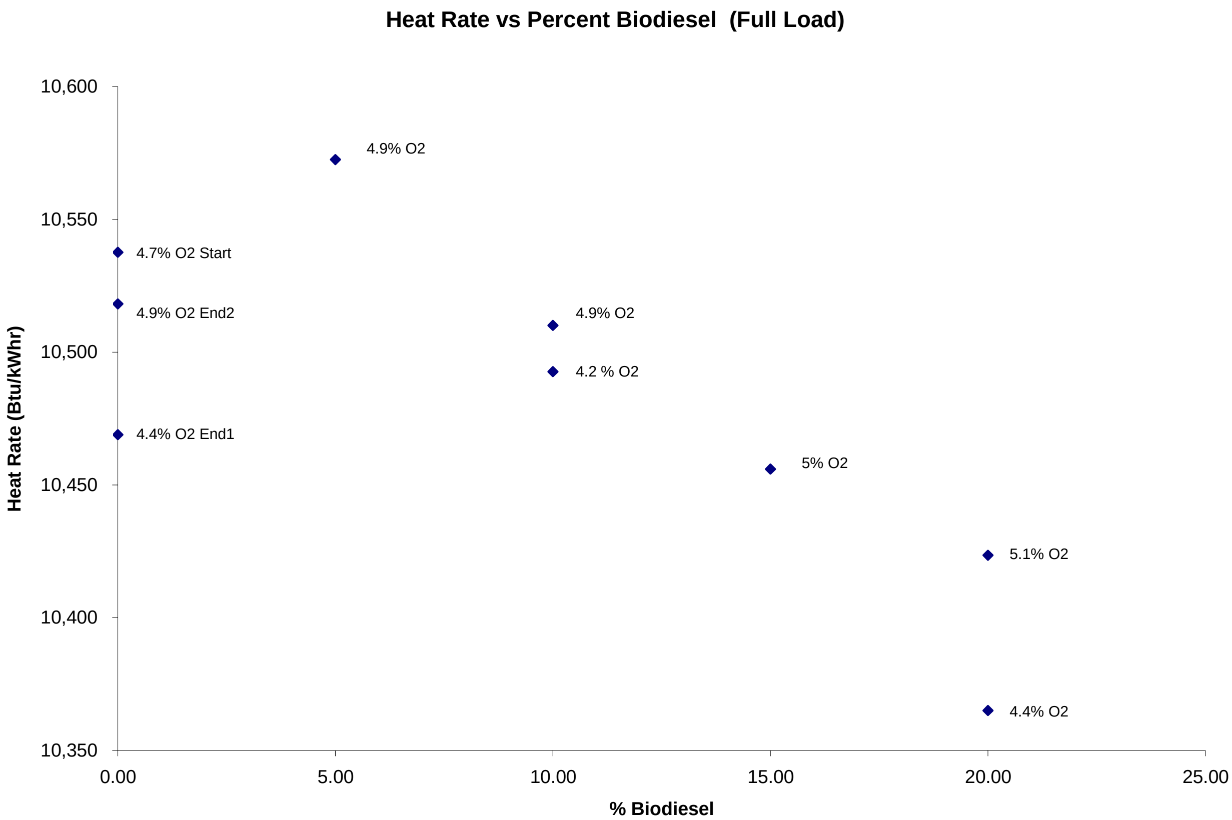

Figure 4-2
Plant Heat Rate vs. Percent Biodiesel in Blend at Full Load

4.2 Impact of Biodiesel Co-Firing on Emissions

4.3 SO_2 Emissions

The reduction in SO_2 emissions with increasing biodiesel is of course consequential to the fact that biodiesel contains significantly less sulfur than oil. Accordingly, by referring the SO_2 data in Appendix A, Figure 4-3 (reduced load) and Figure 4-4 (full load), we see an incremental reduction in SO_2 levels as the biodiesel ratio moves from zero to 20%, which as to be expected, is consistent with reduced level of sulfur reported in the fuel analysis of the various blends given in Appendix C.

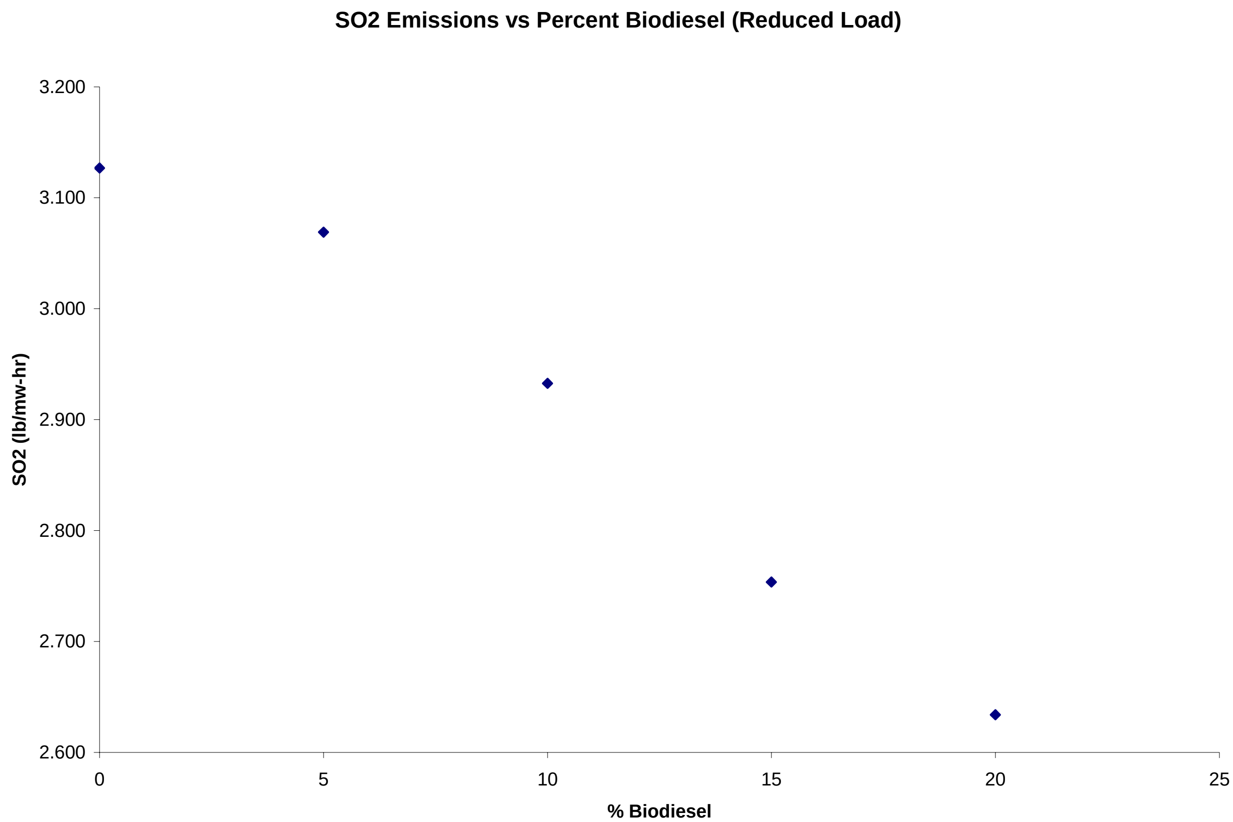

Figure 4-3
SO_2 Emissions at Reduced Load vs. Percent Biodiesel in Blend

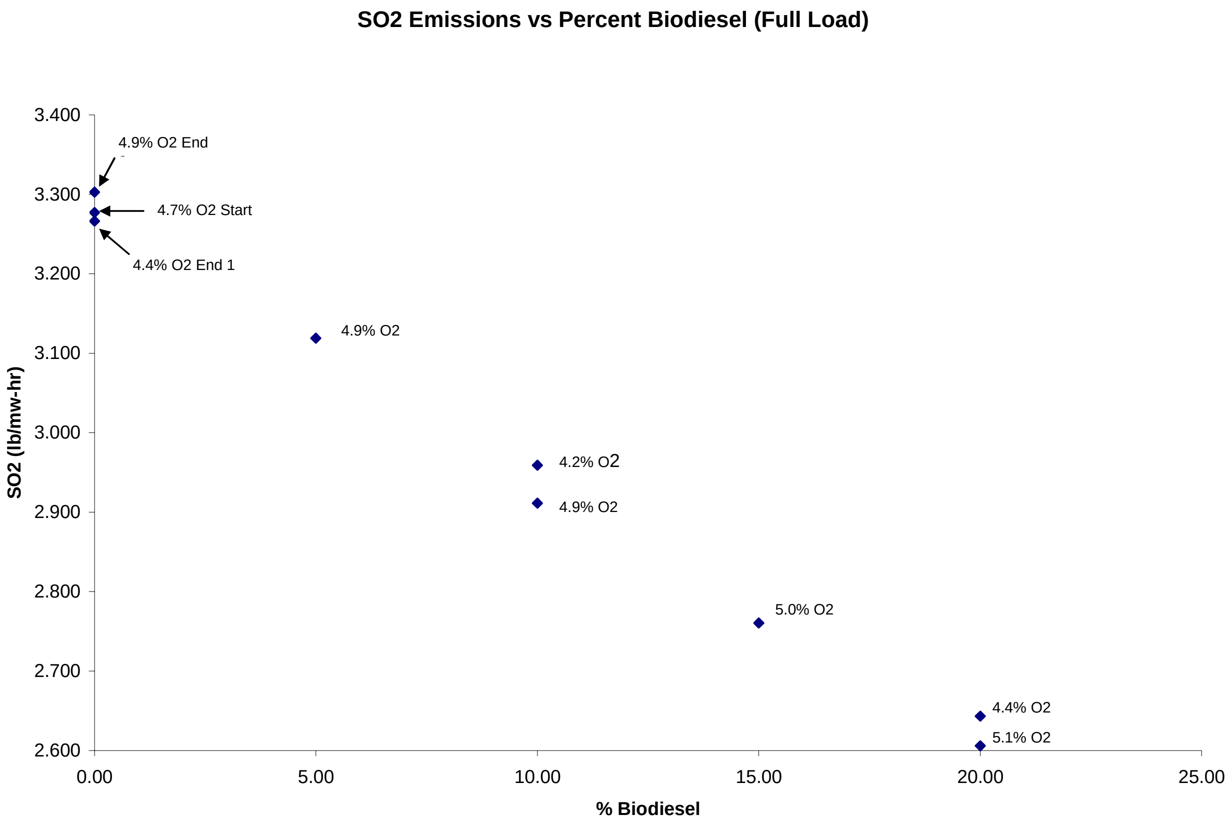

Figure 4-4
SO_2 Emissions at Full Load vs. Percent Biodiesel in Blend

4.4 Metal Emissions

No direct measurement of emissions of metals, such as Nickel and Vanadium were made. The emissions of these metals are directly proportional to the mass of these metals in the fuel. The fuel analysis provided in Appendix C clearly demonstrates that total Nickel in the various percentage biodiesel blends decreased from the base #6 fuel oil and thus it can be assumed the emissions of these metals would decrease while burning bio-diesel blended fuel.

4.5 CO Emissions

Referring to the CO emissions vs. biodiesel percentage data plotted in Figures 4-5 (reduced load) and Figure 4-6 (full load), it is not possible to develop a correlation of the impact of biodeisel on CO. However, referring to the lower O_2 cases run at full load at 0 percent, 10 percent, and 20 percent biodiesel blend ratios (reference Figure 4-6), it is evident that the overriding factor governing CO emissions for a given biodiesel blend ratio is stack O_2, or excess air. This is further substantiated in Figure 4-7, where CO emissions are shown to decrease in proportion to increasing stack O_2, independent of the biodiesel blend ratio. It can therefore be concluded that excess air remains the primary factor governing CO emissions, and the impact of the biodeisel blend ratio is of minor consequence, at least for the tests performed.

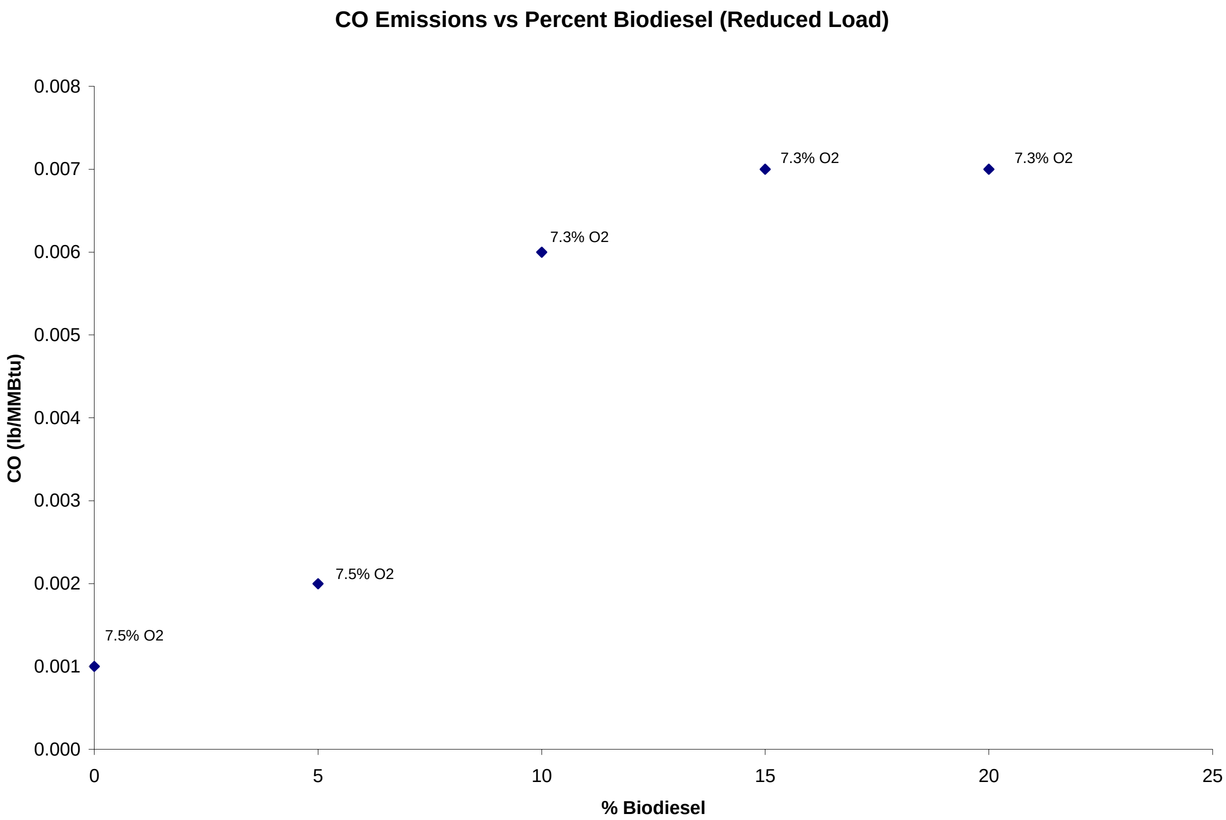

Figure 4-5
CO vs. Percent Biodiesel at Reduced Load

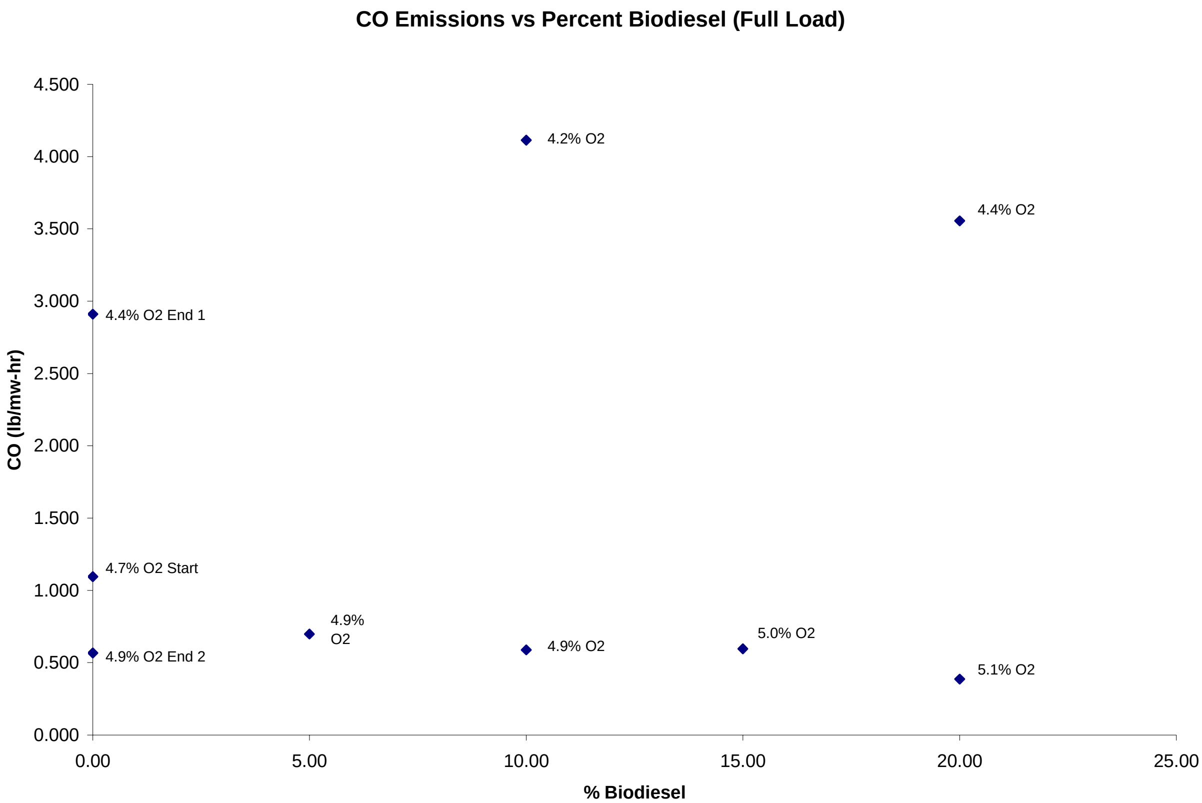

Figure 4-6
CO vs. Percent Biodiesel at Full Load

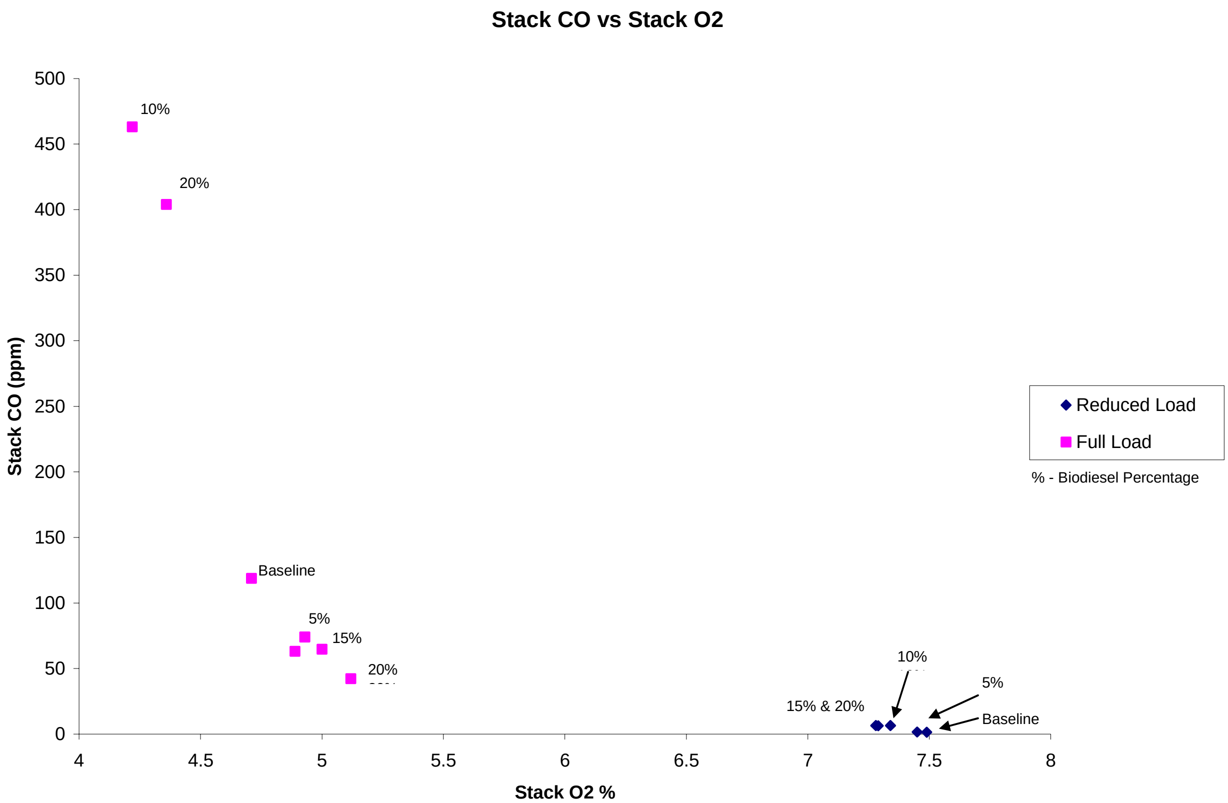

Figure 4-7
CO Emissions vs. Percent Excess O_2 for Both Partial and Full Load

4.6 Particulate and Opacity Emissions

Referring to Figure 4-8 and Figure 4-9, the impact of biodiesel ratio on particulate matter and opacity results were inconclusive as there was not any apparent trend in the results. The following theories were developed to identify the cause.

1. Biodiesel is known to act as a solvent. Biodiesel acts as a de-scaling agent when used in other applications. As a result, there is a possibility that scale from the inside of the fuel oil line was set free. This de-scaling of the fuel oil line could have contributed to higher particulate matter results for certain tests while other tests would have low particulate matter results when there was not significant scale set free.
2. The test method used may have played a factor as well. Specifically, the abbreviated method utilized may have not been suited for the level of detail required.
3. The variance in excess air levels between tests, which was shown to yield a more significant correlation with respect to CO readings than did the percentage of biodiesel in the fuel blend (reference discussion on CO emissions) may also have played a role in the variance with particulate levels. Although a plot of opacity vs. O_2 independent of biodiesel percentage (reference Figure 4-10) is not as telling as a similar plot of CO vs. O_2, it is interesting to note that the lowest opacity level is consistent with the highest O_2 level.

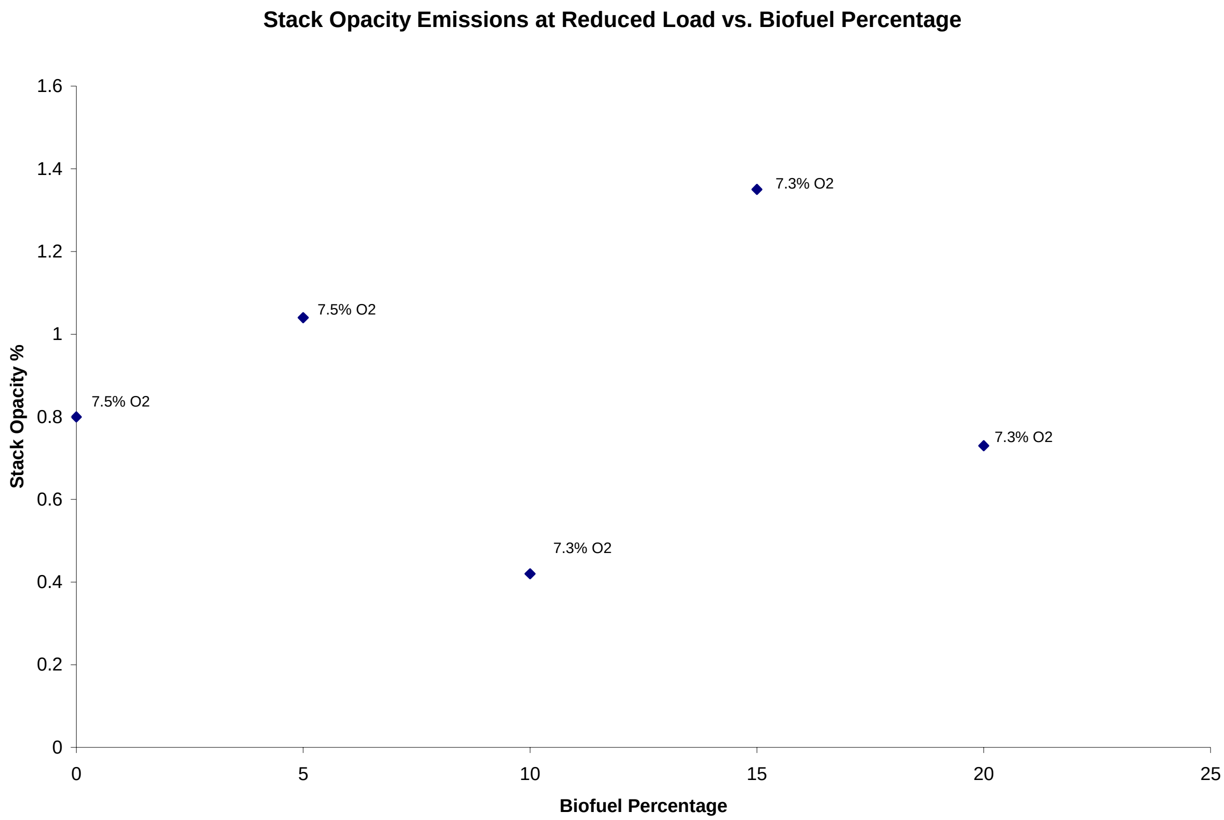

Figure 4-8
Opacity vs. Percent Biodiesel at Reduced Load

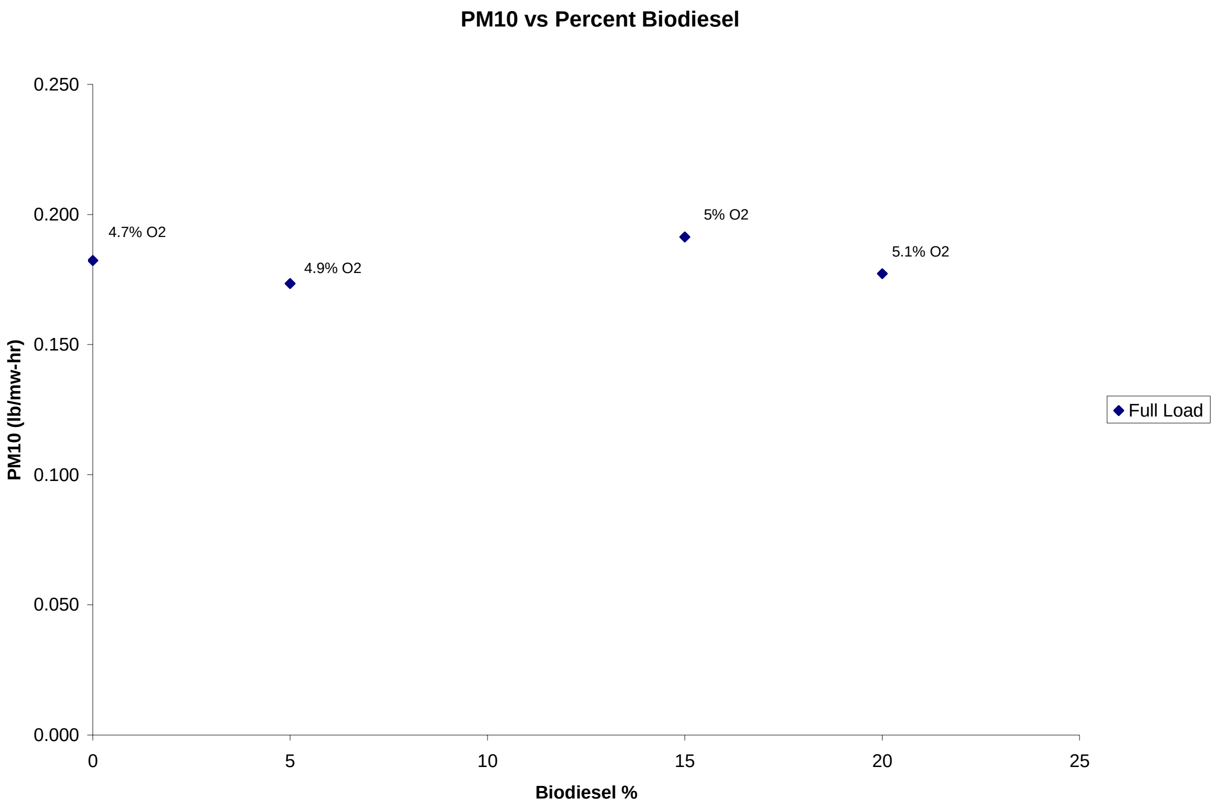

Figure 4-9
PM10 vs. Percent Biodiesel at Full Load

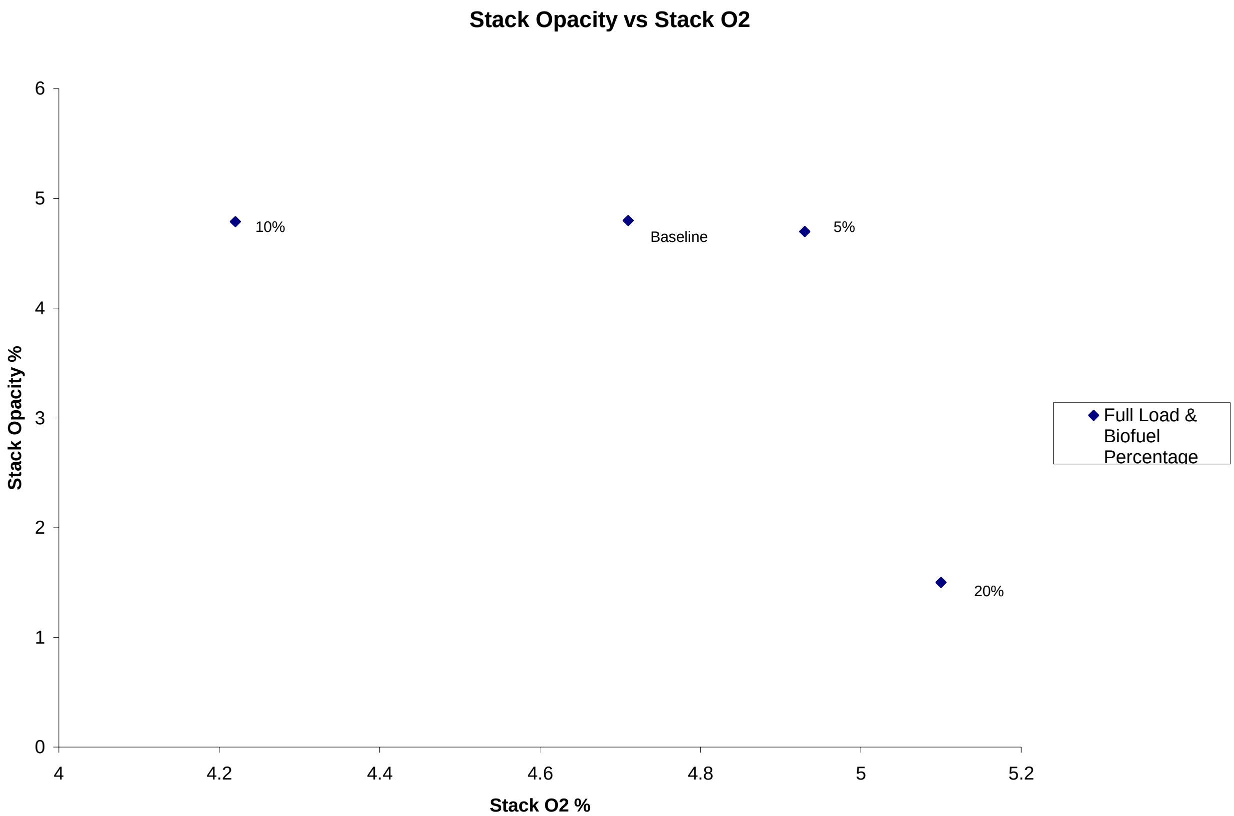

Figure 4-10
Opacity vs. O_2 at Full Load

4.7 NOx Emissions

Due to the fact that the biodiesel fuel, which contains negligible bound nitrogen, was displacing the #6 oil, which contains approximately 0.16 % bound nitrogen, a reduction in NOx with increasing biodiesel may have been anticipated. However, it needs to be recognized that for oil firing, the NOx generated in the combustion process is a complicated combination of both "fuel" derived NOx (e.g., originating from the bound nitrogen in the fuel), as well as "thermal" NOx (e.g., originating from the disassociation of the molecular nitrogen in the combustion air stream). Although the contribution of fuel and thermal NOx towards the total NOx level for a "typical" #6 oil-fired application is thought of as being 50:50, for a specific application this ratio is highly variable, depending on the design characteristics of the furnace, the fuel composition, and unit operation.

With respect to unit design, multi-burn, high heat release rate units such as the Poletti station tend to generate a higher than average percentage of thermal NOx, due to high peak flame temperatures generated. Thermal NOx is formed according to the Zeldovich mechanism, whereby O_2 and N_2 molecules in the combustion air are dissociated at high temperature into their respective atomic states. NOx formation through the Zeldovich mechanism is exponentially proportional to peak temperatures in the flame. Furnaces with high heat release rates, especially those where the individual burners are closely spaced, tend to experience higher peak flame due to the re-radiating effect of the flames, and a limited heat sink in the lower furnace. In addition, the higher volatility of the biodiesel fuel, although beneficial in promoting enhanced flame stability, may serve to further promoted the formation of higher peak flame temperatures in the near combustion zone.

The above discussion may explain why only a marginal reduction in NOx levels was realized when the #6 oil was displaced by the biodiesel fuel when firing at reduced load (reference Figure 4-11), and why virtually no reduction in NOx was realized when firing at peak load (reference Figure 4-12). As load is increased, the furnace heat release rate, and thus the furnace peak flame temperatures, is also increased. Accordingly, the overall contribution of the thermal NOx component to the total NOx produced (e.g., thermal NOx plus fuel) NOx, becomes more pronounced.

As was the case with both CO and particulate matter, we can also see a correlation between NOx emissions and stack O_2, independent of the percentage biodiesel in the blend (reference Figures 4-13 and 4-14).

It should also be noted that the residual oil fired at the Poletti Station is of very high quality, containing only 0.16% N (reference Appendix C fuel analysis). In going from 0% to 20% biodiesel blends, the nitrogen level in the fuel was only reduced from 0.16% to approximately 0.13%. For most residual oil plants, the bound nitrogen in the oil is significantly greater, and accordingly, the ratio of fuel generated NOx to total NOx is also greater. Therefore, it may be anticipated that boidiesel utilization on applications where a lesser quality oil is deployed would realize a greater benefit with respect to NOx reduction.

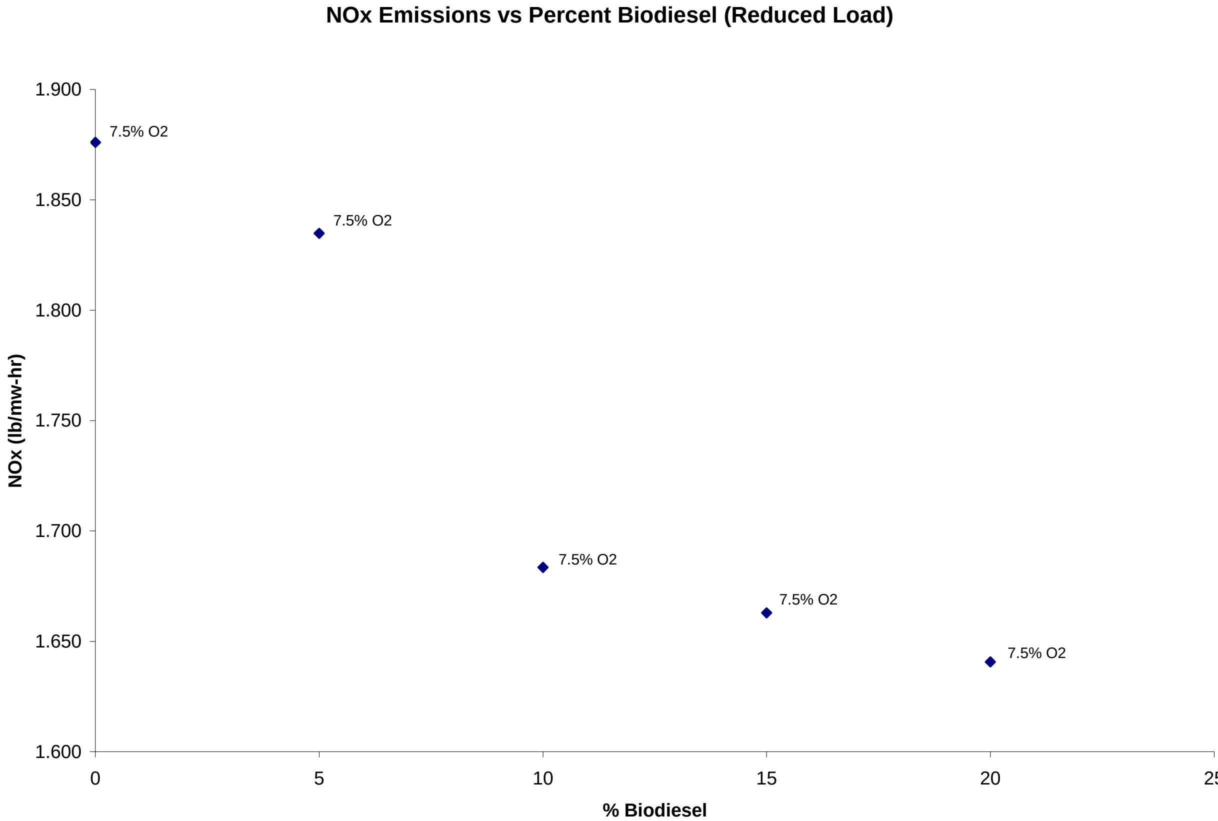

Figure 4-11
NOx vs. Percent Biodiesel at Reduced Load

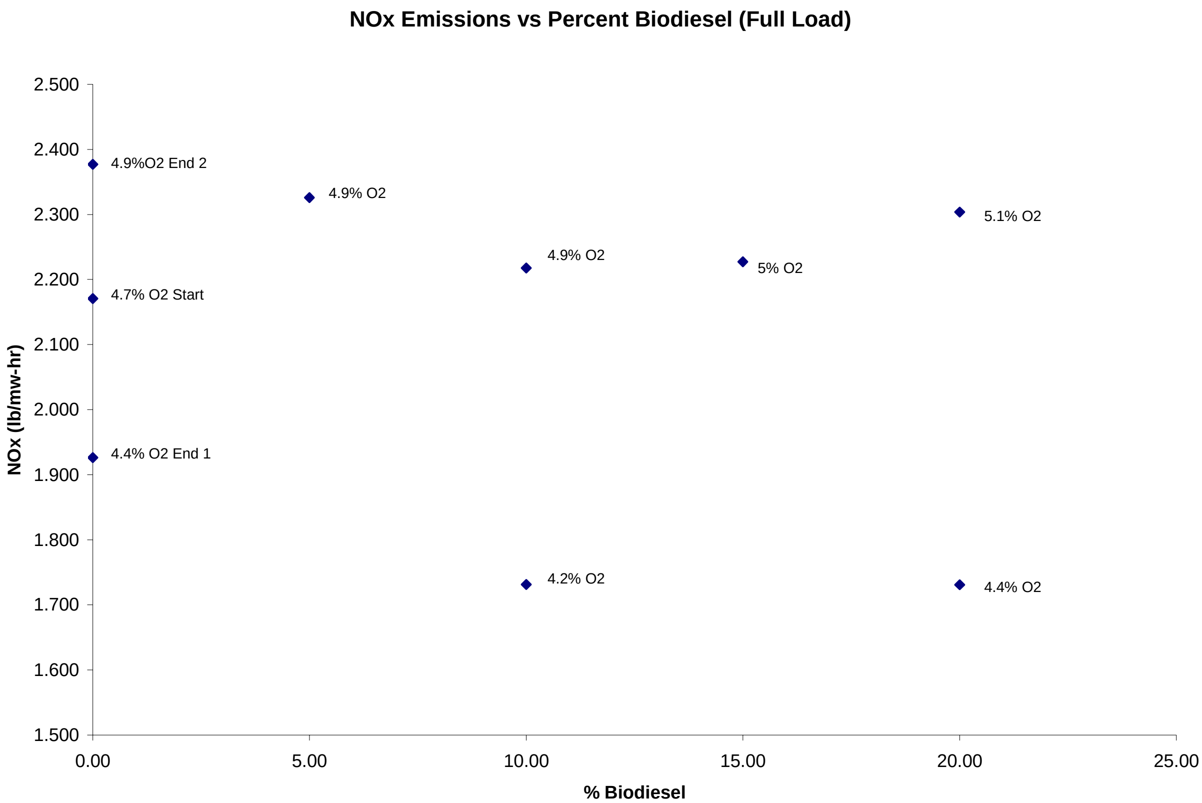

Figure 4-12
NOx vs. Percent Biodiesel at Full Load

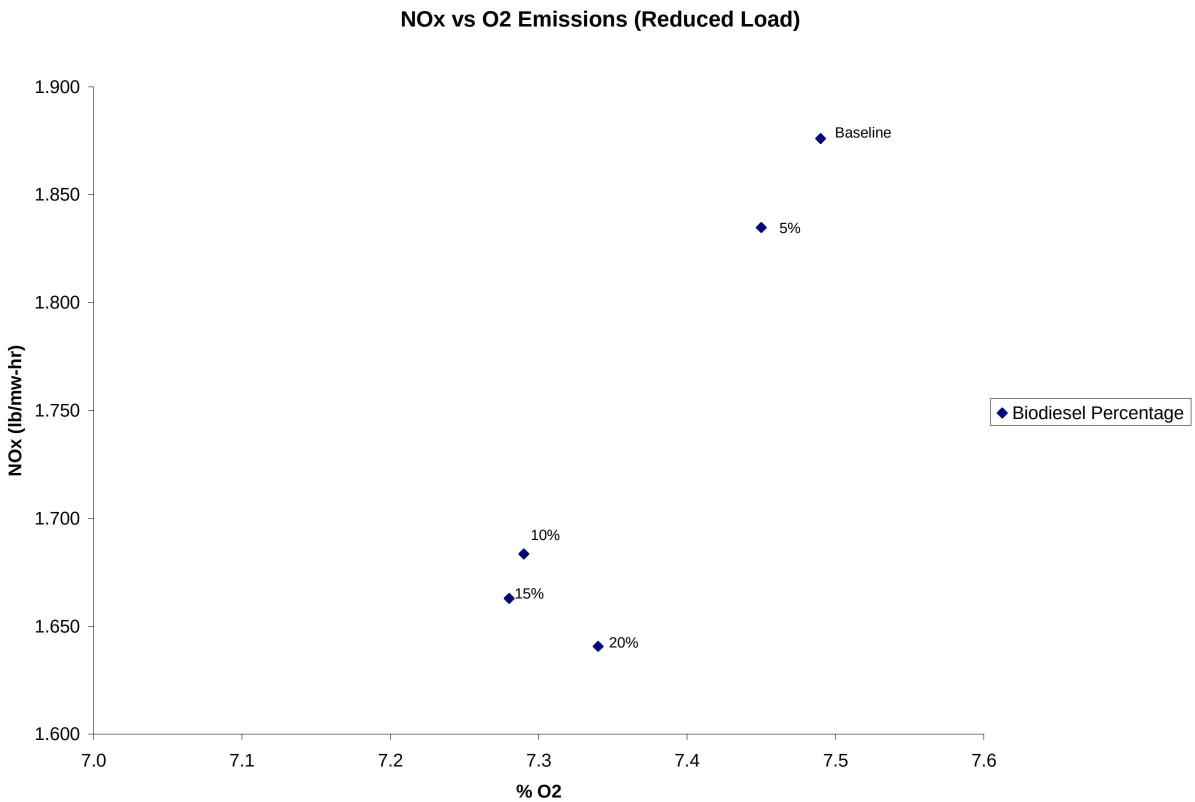

Figure 4-13
NOx vs. Stack O_2 at Reduced Load

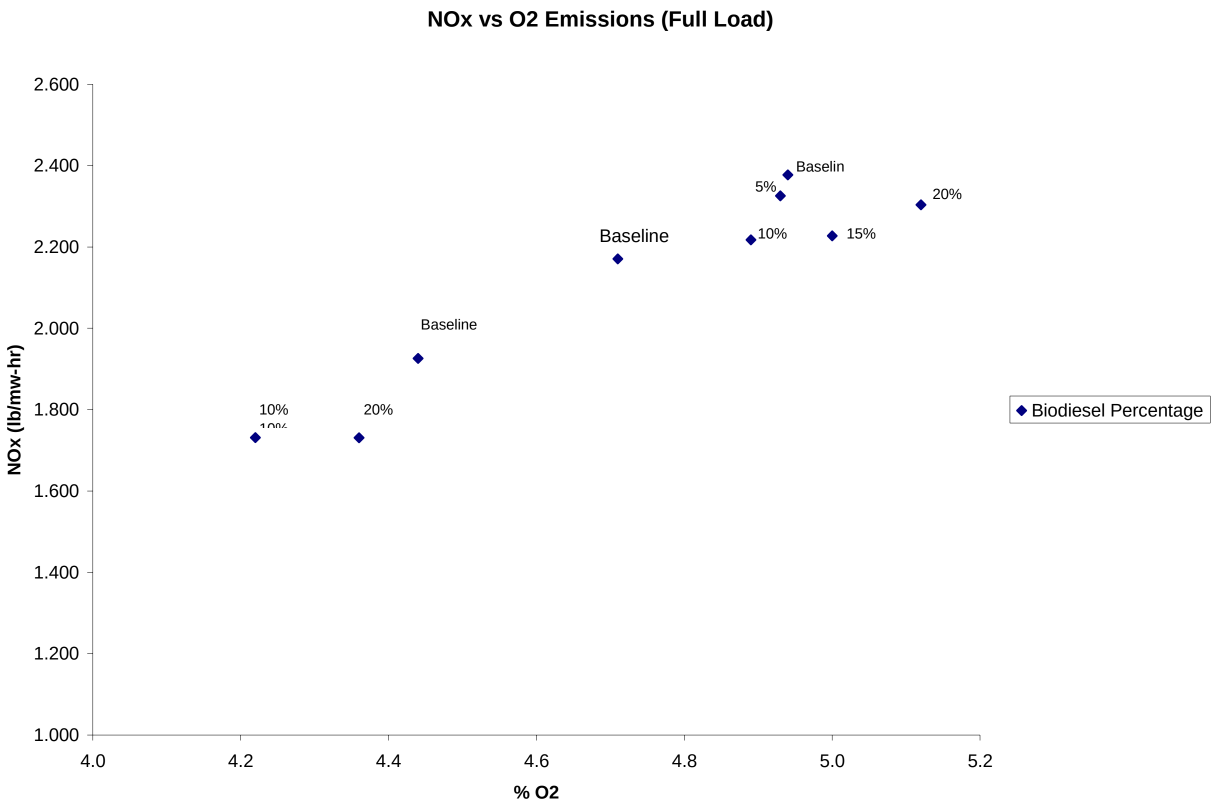

Figure 4-14
NOx vs. Stack O_2 at Full Load

4.8 Impact of Biodiesel on CO_2

Assessing the impact of biodiesel on CO_2 emissions has three components. First, what fraction of the petroleum-based, non-renewable CO_2 is displaced by the biodiesel. Second, what are the financial implications of displacing non-renewable CO_2. And finally, what are the regulatory and policy implications in using biodiesel. This report will address only the first and second issues. The third issue will not be addressed, as the rules of commerce, regulations, and standards for New York City, New York State, the northeast, and the United States are currently developing, and might significantly change the value of firing biodiesel at Poletti.

Regarding the first issue, most of the analyses on the life cycle environmental impacts of biodiesel have been based on the use of biodiesel as a motor fuel. A 1998 lifecycle analysis study funded by DOE and USDA (Sheehan, et al) suggests that biodiesel for motor fuel displaces about 78% of the CO_2 that would be generated by using petroleum-based diesel. As the motors perform substantially the same with biodiesel and petroleum diesel, we will assume that for an oil-fired station, biodiesel will displace 78% of the fossil CO_2.

4.9 Potential Benefit of Credits

For the second issue, calculating the non-capital break-even cost of biodiesel co-firing is straightforward. There are three credits that provide value to the plant's financial statement: the value of the CO_2, the value of reduced SO_2, and Renewable Energy Credits from the State of New York for the fraction of power generated from biodiesel.

<u>CO_2 Value</u>. The Chicago Climate Exchange (chicagoclimatex.com) is North America's only, and the world's first, greenhouse gas (GHG) emission registry, reduction and trading system for all six greenhouse gases (GHGs), and consequently a reliable source for the valuing of CO_2. The goals of CCX are: to facilitate the transaction of greenhouse gas emissions allowance trading with price transparency, to build the skills and institutions needed to cost-effectively manage greenhouse gas emissions, and to facilitate capacity-building in both public and private sector to facilitate greenhouse gas mitigation. The Climate Exchange began offering CO_2 contracts in 2003. Since that time, the price for CO_2, on a per ton basis, has been slightly lower than $1 up about $4.50. The European CO_2 market has had prices over 30/tonne, but prices have recently slumped and were about 7/tonne. On Friday, December 15, 2006, the closing price on the CCFX Carbon Financial Instrument Contracts for 2006 was $4.00 per metric ton of carbon dioxide. The Climate Exchange accepts carbon credits generated from offsets, which is essentially the situation with firing biodiesel at Poletti.

Renewable Portfolio Standard: New York State Research and Development Authority (NYSERDA) administers New York State's Renewable Portfolio standard. On September 24, 2004, the NYS Public Service Commission, issued its "Order Approving Renewable Portfolio Standard Policy." That Order identified the Commission's renewable energy policy and provided definitions and targets for carrying out the policy. The policy called for an increase in renewable energy used in the State from the then current level of about 19% to 25% by the year 2013. Two approaches were identified to achieve that goal: a central procurement approach that would provide for increases to about 24% and a voluntary green market approach that would provide at least the other 1%. The central procurement approach provides for the regulated investor-owned utilities to collect a surcharge on most delivery customer bills and transfer those funds to the New York State Energy Research and Development Authority (NYSERDA) who administers the RPS program for the Commission. NYSERDA enters into contracts to provide incentives, based on actual production, to renewable energy producers who either sell and deliver their energy into the New York wholesale market or will provide funding for customers to install such facilities "behind the meter". Conversations with NYSERDA revealed that the average price paid under the first competitive procurement was approximately 22 $/MWh. Biodiesel is a "Qualifying" Biomass fuel as defined in NYSERDA's definition document.

The value of SO_2 is determined by the market, and varies widely with time. Most recently on the Cantor Fitzgerald Environmental Exchange, the value for a ton of SO_2 was hovering around $200.

Figure 4-15 shows the relationship between the value provided by displacing CO_2 from petroleum and the incremental price that NYPA could afford to pay above the price of their standard #6 oil. This figure includes the value of renewable energy, and so it is possible to generate additional value firing biodiesel, even if the value received from CO_2 reductions is near zero. The figure also shows the incremental value accrued from the sulfur reductions, which are fairly minor compared to the CO_2 and renewable values.

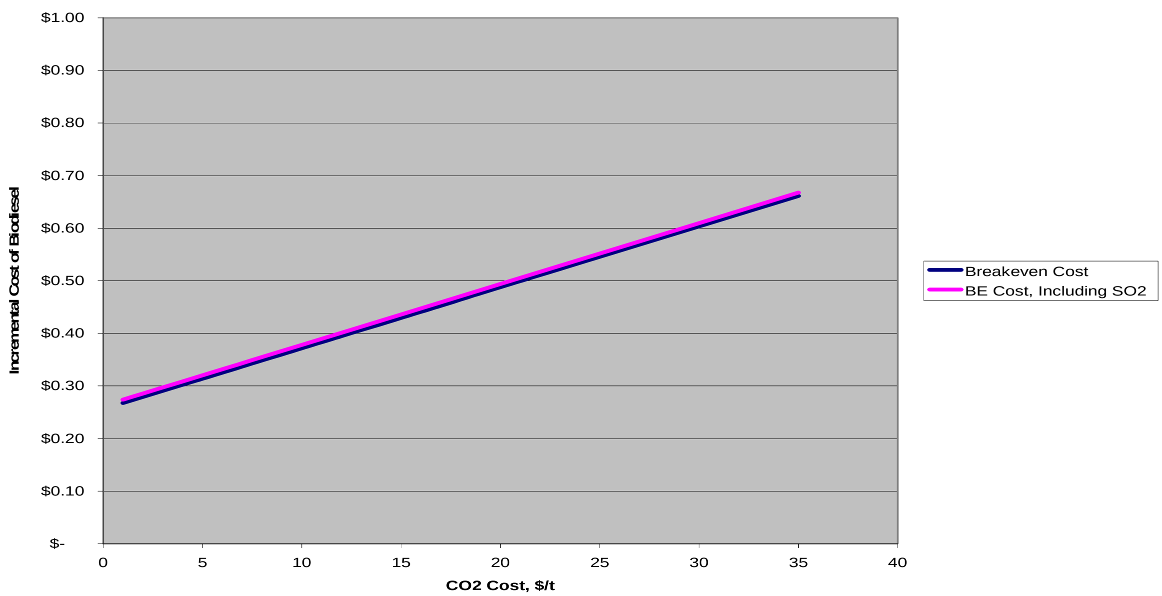

Figure 4-15
Incremental Cost of Biodiesel vs. CO_2 Cost

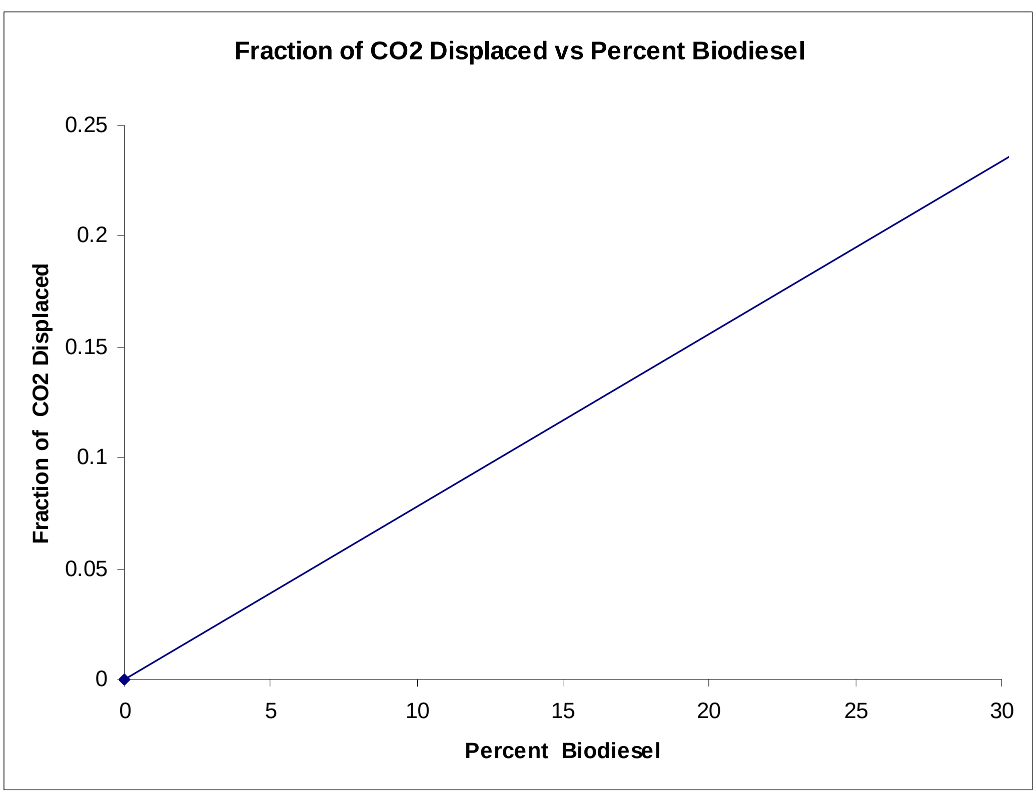

Figure 4-16
Fraction of Carbon Dioxide Capture verses Percent Biodiesel

5 CONCLUSIONS AND RECOMMENDATIONS

This demonstration represented the first of a kind deployment of biodiesel co-firing with residual oil in a large scale power producing application. The demonstration was highly successful, and no issues regarding operability and performance were experienced at biodiesel blend ratios up to 20 percent. All emissions were either reduced, or as a minimum, did not experience an increase.

Although there was no increase in any measurable emissions, with respect to NOx, at best only a marginally reduction was achieved. As explained in the proceeding section of this report, this was most likely due to the increased volatility of the biodiesel, which although beneficial with respect to combustion stability, may have yielded an increase in thermal NOx formation, which to a large degree counteracted any reduction in NOx formation from the lower bound nitrogen in the biodiesel / residual oil fuel blend. This was especially pronounced at the higher load, due to the increase in unit heat release rate, which is proportional to unit load. In addition, the nitrogen level in the residual oil fired at the Poletti Station is relatively low (.16%). Accordingly, the total NOx production originating from the fuel component is of lesser significance than would be the case for other applications where the nitrogen level in the fuel is more typical of what would be found in residual fuel oil.

On a life-cycle basis, biodiesel produces 78% of the CO_2 that would be generated by using petroleum-based fuel. If Poletti were to burn 100% biodiesel, the unit would produce 22% of the CO_2 now emitted. As seen in Figure 4-16, the displacement of CO_2 decreases linearly with the fraction of biodiesel used. At 20% biodiesel, about 15% of the CO_2 is displaced by the "greener" fuel.

It was interesting to note that NOx, CO, and opacity showed greater sensitivity to relatively minor variations in excess air than with incremental changes in the percent of biodiesel utilized. It was also interesting to note an improvement in plant heat rate as the percentage of biodiesel was increased.

Biodiesel blends of up to 20 percent were demonstrated during the 2-day test program, at both reduced (approximately 400 MW) and high (approximately 750 MW) loads. As no noticeable change in boiler operability was encountered, one recommendation for future testing might include going to higher blend ratios, to assess if a point exists at which a significant change in unit operability occurs. Based on the results of this demonstration, all that can be concluded is that if a blend ratio limitation does exist, it occurs at a point somewhere above 20 percent biodiesel heat input.

In applying biodiesel co-firing beyond the NYPA Poletti boiler #6, application specific considerations would include fuel quality, boiler design, and boiler operation, all of which would impact test results. With respect to fuel quality, since the residual oil fired at the NYPA Poletti station is of relative high quality (especially with respect to low sulfur and nitrogen content), it may be assumed that enhanced benefits would be realized at plants firing a lesser quality oil. With respect to unit design, as has been already pointed out, the Poletti station is a relatively high heat release rate unit. Units with lower heat release rates may experience enhanced NOx reduction levels, due to a greater bias towards fuel NOx to thermal NOx ratios. Finally, with respect to boiler operation, the Poletti unit utilizes both overfire air as well as forced flue gas recirculation for NOx control. Units without NOx controls, or units with a different set of NOx controls, may respond differently.

A
TEST RESULTS

			400MW - Baseline	400 MW- 5%	400MW - 10%	400 MW - 15%	400MW - 20%
			10/24/06 8:21	10/24/06 10:50	10/24/06 13:25	10/24/06 15:30	10/24/06 17:32
			10/24/06 9:40	10/24/06 12:05	10/24/06 14:32	10/24/06 16:45	10/24/06 18:40
Test Measurements							
	Units	**TAG # (Source)**					
TEST DESCRIPTION							
Percent Biodiesel	%		0%	5%	10%	15%	20%
Generator Load (MWnet)	MWnet	P6.V.C002NET	403.68	404.78	404.74	406.50	401.99
Generator Load (MWG)	MWG	P6.V.A0001	419.30	420.09	420.04	421.82	417.33
Auxially Load	MWaux	P6.V.A1314	15.58	15.40	15.28	15.18	15.14
Fuel Heating Value (from analysis)	Btu/gal	Lab analysis	150,100	148,820	147,400	146,380	145,010
Plant Heat Rate	Btu/kWhr	Calculation	10,971	10,922	10,862	10,798	10,794
Excess Air (% O2 dry) AH Inlet	% dry	TRC Solutions	6.55%	6.55%	6.40%	6.50%	6.30%
Dilution Air (%)	%	From Chart					
Overfire Air Ports	% open		10%	10%	10%	10%	10%
Burners Out of Service			7 pair out	7 pair out	7 pair out	7 pair out	7 pair out
Fuel and Burner Info							
BIODIESEL FLOW	GPM	Manual Measurement	-	25.0	51.0	74.0	100.0
FUEL OIL FLOW TO HEADER	GPM	CALCULATION	491.8	495.1	497.1	499.8	498.7
FUEL OIL FLOW TO HDR - CFX2671	GPM	P6.V.A1500	496.92	498.88	500.12	502.11	498.73
FUEL OIL FLOW TO HDR - FX2670	GPM	P6.V.A1501	489.72	488.32	489.51	491.84	490.38
FO RETURN FLOW METER - CFX2674	GPM	MANUAL	5.16	3.77	3.05	2.32	0.00
FO HEADER RETURN TEMP		P6.V.A1571	197.60	181.92	171.96	158.54	153.41
FUEL OIL TEMPERATURE (at Meter)	deg. F	P6.V.A1541	201.55	183.06	173.96	155.63	147.80
FUEL OIL TO HEATERS TEMP	°F	P6.V.A1510	126.64	125.98	127.94	124.51	120.99
HEAT ABSORBED BY FUEL OIL	MMBTU/HR	CALCULATION	7.3	5.6	4.5	3.1	2.6
FUEL OIL PRESSURE	psig	P6.V.A1531	203.01	200.79	197.73	197.69	192.59
ATOMIZING STEAM PRESS	psig	P6.V.A1590	165.75	165.44	164.91	164.66	164.07
ATOMIZING STEAM FLOW	lb/hr	P6.V.C1591	13973.17	14226.12	14398.37	14593.63	14770.65
ATOMIZING STEAM TEMP	deg. F	P6.V.A1589	377.65	377.59	377.31	377.17	377.06
FUEL OIL SUPPLY PRESS	psig	P6.V.A1509	626.81	646.30	645.59	610.12	610.84
FO HTR STEAM PRESS # 1	psig	P6.V.A1511	71.18	42.16	30.03	17.22	13.05
FO HEATER # 1 STEAM TEMP	°F	P6.V.A1512	330.47	313.89	304.57	287.91	286.43
FO HEATER # 1 DRAIN TEMP	°F	P6.V.A1513	236.01	215.05	204.68	176.01	154.80
FO HTR DRN COOLER # 1 TEMP	°F	P6.V.A1514	139.84	133.31	131.94	125.57	121.26
FO OUT DRN CLR # 1 TEMP	°F	P6.V.A1515	133.68	130.32	130.58	125.97	122.27
FUEL OIL OUTL HTR # 1 TEMP	°F	P6.V.A1516	199.17	180.29	171.29	152.95	144.75
FUEL OIL FROM HEATERS	°F	P6.V.A1517	199.17	180.40	171.47	153.52	145.49
FO HTR STM PRESS # 2	psig	P6.V.A1521	-0.39	-0.38	-0.39	-0.43	-0.43
FO HEATER # 2 STEAM TEMP	°F	P6.V.A1522	100.99	104.37	105.67	105.51	104.39
FO HEATER # 2 DRAIN TEMP	°F	P6.V.A1523	66.82	66.44	68.12	68.82	68.72
FO HTR DRN COOLER # 2 TEMP	°F	P6.V.A1524	69.74	68.92	68.63	68.89	68.90
FO OUT DRN CLR # 2 TEMP	°F	P6.V.A1525	71.95	71.55	71.64	71.44	71.25
FUEL OIL OUTL HTR # 2 TEMP	°F	P6.V.A1526	141.21	140.78	140.63	140.69	140.38
OIL BURNER HDR PRES - 3 - PX2670	psig	P6.V.A1531	203.01	200.79	197.73	197.69	192.59
FO HEADER PRES LOWER	psig	P6.V.A1532	207.35	205.02	201.90	201.70	196.68
FO HEADR PRES CENTER	psig	P6.V.A1533	206.82	204.80	201.59	201.59	196.67
FUEL OIL HEADER TEMP	°F	P6.V.A1541	201.55	183.06	173.96	155.63	147.80
FUEL OIL HEADER TEMP - UPPER	°F	P6.V.A1542	133.37	126.25	120.81	116.60	113.26
FUEL OIL HEADER TEMP - LOWER	°F	P6.V.A1543	199.90	181.71	172.89	154.68	146.98
FO HEADER TEMP - MIDDLE	°F	P6.V.A1544	198.86	180.68	172.06	154.24	146.43

			400MW - Baseline	400 MW- 5%	400MW - 10%	400 MW - 15%	400MW - 20%
			10/24/06 8:21	10/24/06 10:50	10/24/06 13:25	10/24/06 15:30	10/24/06 17:32
			10/24/06 9:40	10/24/06 12:05	10/24/06 14:32	10/24/06 16:45	10/24/06 18:40
Test Measurements							
	Units	**TAG # (Source)**					
TEST DESCRIPTION							
Percent Biodiesel	%		0%	5%	10%	15%	20%
Generator Load (MWnet)	MWnet	P6.V.C002NET	403.68	404.78	404.74	406.50	401.99
Generator Load (MWG)	MWG	P6.V.A0001	419.30	420.09	420.04	421.82	417.33
FO HEADER RETURN TEMP	°F	P6.V.A1571	197.60	181.92	171.96	158.54	153.41
FO SYSTEM RETURN TEMP	°F	P6.V.A1572	131.04	130.21	136.70	127.91	124.25
FUEL FORWARDING PUMPS							
FUEL FWD PUMP A							
A MOTOR AMPS	AMPS	Manual	O/S	O/S	O/S	O/S	O/S
A INLET PRESSURE	psig	Manual	O/S	O/S	O/S	O/S	O/S
A OUTLET TEMPERATURE	°F	Manual	O/S	O/S	O/S	O/S	O/S
FUEL FWD PUMP B							
B MOTOR AMPS	AMPS	Manual	21.00	19.00	17.50	16.50	19.50
B INLET PRESSURE	psig	Manual	5.5	6.00	6.00	6.00	6.00
B OUTLET TEMPERATURE	°F	Manual	116.50	115.00	115.00	116.00	115.00
FUEL FWD PUMP C							
C MOTOR AMPS	AMPS	Manual	20.00	17.50	16.00	O/S	O/S
C INLET PRESSURE	psig	Manual	7.00	7.00	7.50	7.30	O/S
C OUTLET TEMPERATURE	°F	Manual	116.50	115.00	115.00	116.00	O/S
Air Flow							
Temperatures							
Ambient Air Temperature	deg. F						
AH1 Inlet Air Temperature (average)	deg. F	average	102.54	104.12	106.29	106.23	106.38
AH2 Inlet Air Temperature (average)	deg. F	average	101.13	102.66	105.08	105.04	105.07
AH1 Outlet Air Temperature (average)	deg. F	average	538.82	549.72	553.26	553.50	553.57
AH2 Outlet Air Temperature (average)	deg. F	average	502.78	503.91	505.26	506.60	506.30
North Dil Air Outlet - Mixture Temp	deg. F	average	529.24	530.21	531.75	532.72	532.63
South Dil Air Outlet - Mixture Temp	deg. F	average	528.00	529.49	531.21	531.65	527.87
Windbox Temperature	deg. F	average	528.62	529.85	531.48	532.18	530.25
Pressures							
Air Heater Inlet Air pressure	in. WC						
Air Heat Outlet Air pressure	in. WC						
Dilution Air pressure	in. WC						
Windbox pressure	in. WC						
FURNACE DRAFT - A -CPX36	inH2Oa	P6.V.A2330	-0.48	-0.48	-0.48	-0.46	-0.47
FURNACE DRAFT 1 - B - PX361	inH2Oa	P6.V.A1330	-0.49	-0.49	-0.48	-0.47	-0.49
IDF 61 SUCTION - CPX 3911	inH2Oa	P6.V.A1150	-8.28	-8.01	-7.55	-7.68	-7.72
IDF 62 SUCTION - CPX3921	inH2Oa	P6.V.A2150	0.00	0.00	0.00	0.00	0.00
IDF 63 SUCTION - CPX3931	inH2Oa	P6.V.A3150	-8.34	-8.30	-8.19	-8.25	-8.19
Gas Flow							
Temperatures							
Furnace Exit Gas Temperature	deg. F	TRC Solutions	1500	1477	1488	1451	1477
Average AH1 Inlet Gas Temperature	deg. F	calc	576.77	578.68	580.42	581.66	581.35
Average AH2 Inlet Gas Temperature	deg. F	calc	603.70	603.55	605.51	607.79	606.90
Average AH1 Outlet Gas Temperature	deg. F	calc	256.90	259.30	261.95	262.63	263.10
Average AH2 Outlet Gas Temperature	deg. F	calc.	248.30	250.20	252.52	253.71	253.83

			400MW - Baseline	400 MW- 5%	400MW - 10%	400 MW - 15%	400MW - 20%
			10/24/06 8:21	10/24/06 10:50	10/24/06 13:25	10/24/06 15:30	10/24/06 17:32
			10/24/06 9:40	10/24/06 12:05	10/24/06 14:32	10/24/06 16:45	10/24/06 18:40
Test Measurements							
	Units	**TAG # (Source)**					
TEST DESCRIPTION							
Percent Biodiesel	%		0%	5%	10%	15%	20%
Generator Load (MWnet)	MWnet	P6.V.C002NET	403.68	404.78	404.74	406.50	401.99
Generator Load (MWG)	MWG	P6.V.A0001	419.30	420.09	420.04	421.82	417.33
Gas Pressures and Damper Positions							
Airheater Inlet Gas Pressure	in. WC						
Airheater Outlet Gas Pressure	in. WC						
SH PASS DMPR 1 POSN - PD101711	%	P6.V.A2380	41.06	40.90	41.25	41.15	47.27
SH PASS DMPR DRV 2 - PD101721	%	P6.V.A2381	40.94	40.90	40.98	40.96	46.04
SH PASS DMPR DRV 3 - PD101731	%	P6.V.A2382	-25.00	-25.00	-25.00	-25.00	-25.00
SH PASS DMPR 4 POSN - PD101741	%	P6.V.A2383	43.74	43.68	44.66	44.64	52.07
SH PASS DMPR DRV 5 - PD101751	%	P6.V.A2384	61.81	61.78	61.73	61.74	65.34
SH PASS DMPR DRV 6 - PD101761	%	P6.V.A2385	61.99	62.01	62.02	62.06	65.56
RH PASS DMPR 1 POSN - PD05011	%	P6.V.A1380	99.52	99.36	98.98	98.81	98.78
RH PASS DMPR DRV 2 - PD05021	%	P6.V.A1381	99.76	99.72	99.73	99.73	99.74
RH PASS DMPR DRV 3 - PDO5031	%	P6.V.A1382	99.83	99.74	99.64	99.59	99.59
RH PASS DMPR 4 POSN - PDO5041	%	P6.V.A1383	90.48	99.91	99.82	99.76	99.77
RH PASS DMPR 5 POSN - PD05051	%	P6.V.A1384	99.20	99.19	99.16	99.15	99.15
RH PASS DMPR DRV 6 - PD05061	%	P6.V.A1385	17.00	17.00	17.00	17.00	17.00
ID Fan Inlet Gas Pressure	in. WC						
ID Fan Outlet Gas Pressure	in. WC						
Test Measurements (continued)							
Emissions							
Windbox % O2 (North)	%	TRC Solutions	19.0	19.0	18.9	19.0	18.9
Windbox % O2 (South)	%	TRC Solutions	19.0	19.0	18.9	19.0	18.9
Air Heater Inlet %O2 (North)	%	TRC Solutions	7.2	6.9	6.8	6.8	6.5
Air Heater Inlet %O2 (South)	%	TRC Solutions	5.9	6.2	6.0	6.2	6.1
CEMS NOx	ppm dry	CEMS DATA	93.2	92.0	86.4	85.6	84.5
CEMS OPACITY	%	CEMS DATA	6.7	5.5	5.5	5.5	5.5
CEMS O2	%	CEMS DATA	5.97	5.90	5.75	5.73	5.77
STACK O2	%	TRC Solutions	7.5	7.5	7.3	7.3	7.3
STACK OPACITY	%	TRC Solutions	0.8	1.0	0.4	1.4	0.7
STACK NOx	lb/MMBtu	TRC Solutions	0.171	0.168	0.155	0.154	0.152
STACK CO	ppm	TRC Solutions	1.3	1.5	6.2	6.4	6.4
STACK CO	lb/MMBtu	TRC Solutions	0.001	0.002	0.006	0.007	0.007
STACK PM10	lb/MMBtu	TRC Solutions	0.0214	0.0142	0.0155	0.0217	0.0336
STACK SO2	lb/MMBtu	TRC Solutions	0.285	0.281	0.270	0.255	0.244
STACK CO	lb/mw-hr		0.011	0.022	0.065	0.076	0.076
STACK PM10	lb/mw-hr		0.235	0.155	0.168	0.234	0.363
STACK SO2	lb/mw-hr		3.127	3.069	2.933	2.754	2.634
STACK NOx	lb/mw-hr		1.876	1.835	1.684	1.663	1.641
Steam							
MS Flow	klbs/hr	Calculated (FW + Spray)					
MAIN STEAM FLOW	kPPH	P6.V.C4000	2,917.1	2,913.1	2,903.4	2,911.9	2,882.8
MAIN STEAM BLR OUTL PRESS	psig	P6.V.A4000	1,142.1	1,141.6	1,139.5	1,142.3	1,131.3
MAIN STEAM TEMP	°F	P6.V.A0960	628.0	628.0	628.0	628.0	628.0
MAIN STM FSH OUTLET AVG TEMP	°F	P6.V.C4001	974.4	974.8	979.0	980.0	980.8
MN STM FSH OUT NE GMC TEMP	°F	P6.V.A4003	500.0	500.0	500.0	500.0	500.0

			400MW - Baseline	400 MW- 5%	400MW - 10%	400 MW - 15%	400MW - 20%
			10/24/06 8:21	10/24/06 10:50	10/24/06 13:25	10/24/06 15:30	10/24/06 17:32
			10/24/06 9:40	10/24/06 12:05	10/24/06 14:32	10/24/06 16:45	10/24/06 18:40
Test Measurements							
	Units	**TAG # (Source)**					
TEST DESCRIPTION							
Percent Biodiesel	%		0%	5%	10%	15%	20%
Generator Load (MWnet)	MWnet	P6.V.C002NET	403.68	404.78	404.74	406.50	401.99
Generator Load (MWG)	MWG	P6.V.A0001	419.30	420.09	420.04	421.82	417.33
MN STM FSH OUT SW GMC TEMP	°F	P6.V.A4004	500.0	500.0	500.0	500.0	500.0
MN STM FSH OUTL N-E TEMP	°F	P6.V.A4001	975.4	975.7	979.7	980.9	981.6
MN STM FSH OUTL S-W TEMP	°F	P6.V.A4002	973.4	973.9	978.2	979.2	980.0
Lwr SH Spray Flow	MPPH	P6.V.C0872	406.8	387.5	380.6	387.1	405.3
Lwr SH Spray Flow Xmitter dP	inH2Oa	P6.V.CFX1024S	9.230	9.276	9.211	9.439	9.185
Uppr SH Spray Flow	MPPH	P6.V.C0882	29.5	29.5	29.7	29.6	29.3
Uppr SH Spray Flow Xmitter dP	inH2Oa	P6.V.CFX1034S	0.449	0.454	0.455	0.459	0.447
SH SPRAY WATER TEMP	°F	P6.V.A0870	438.6	438.7	438.8	439.0	437.9
SH SPRAY WATER PRESS	psig	P6.V.A0871	1,371.0	1,369.0	1,366.5	1,368.7	1,358.7
DRUM # 1 PRESSURE - CPX011	psig	P6.V.A0908	1,262.0	1,260.7	1,258.0	1,261.3	1,249.4
DRUM # 2 PRESSURE - CPX012	psig	P6.V.A0909	1,254.4	1,253.2	1,251.2	1,254.8	1,243.2
COLD RH - DESUP INLT TEMP	°F	P6.V.A0980	691.5	692.4	695.7	696.7	697.9
COLD RH - DESUP OUTL TEMP	°F	P6.V.A0981	689.4	690.5	693.7	694.9	695.8
COLD RH - DESUP OUTL TEMP	°F	P6.V.A0982	667.0	667.0	667.0	667.0	667.0
CRH Steam Flow	klb/hr						
AVERAGE HOT REHEAT TEMP	deg. F	P6.V.C005HRHT	1,008.4	1,010.2	1,013.9	1,017.0	1,016.6
HOT RH PRESS AT TURB	psig	P6.V.A4202	317.0	316.9	316.3	317.4	314.2
RH SPRAY FLOW RATE	lb/h	P6.V.C0892	558,208.5	560,902.3	568,077.6	572,483.4	572,514.3
RH STEAM FLOW	klb/hr	P6.V.C209RHF	2,713.9	2,707.9	2,694.9	2,703.0	2,677.5
HRH Steam Temperature	deg. F						
HRH Steam Pressure	psig						
Feedwater							
FW Flow	klbs/hr	P6.V.C0813	5,865.5	5,437.6	5,286.1	5,440.2	5,813.1
FW Flow Transmitter dP	inH2Oa	P6.V.CFX20S	138.0	136.6	135.6	136.0	133.2
FW Temperature	deg. F	P6.V.A0803	438.9	438.9	439.0	439.1	438.1
FW Pressure	psig	P6.V.A0804	1,206.1	1,205.1	1,203.8	1,208.3	1,197.2
HEATER # 1S STEAM TEMP	°F	P6.V.A0111	185.3	186.3	188.3	189.1	189.7
HEATER # 1S PRESURE	psia	P6.V.A0112	10.2	10.2	10.2	10.2	10.2
HEATER # 1S DRAIN TEMP	°F	P6.V.A0113	108.9	107.9	107.6	107.4	107.8
HEATER # 1S CNDS OUT TEMP	°F	P6.V.A0117	151.7	151.7	151.6	151.6	151.4
HEATER # 1S CNDS IN TEMP	°F	P6.V.A0118	100.7	99.3	98.9	98.9	99.2
HEATER # 1N STEAM TEMP	°F	P6.V.A0121	197.3	197.8	199.5	199.8	201.3
HEATER # 1N PRESSURE	psia	P6.V.A0122	5.7	5.6	5.6	5.6	5.6
HEATER # 1N DRAIN TEMP	°F	P6.V.A0123	107.9	107.1	107.0	106.9	107.4
HEATER # 1N CNDS OUT TEMP	°F	P6.V.A0127	145.7	146.1	147.3	147.9	146.2
HEATER # 1N CNDS IN TEMP	°F	P6.V.A0128	100.8	99.5	99.2	98.9	99.5
LP TURB 16 IN EXTR TEMP	°F	P6.V.A0210	360.6	362.9	366.2	367.9	368.6
HEATER # 2S STEAM TEMP	°F	P6.V.A0211	359.2	361.5	364.9	366.6	367.3
HEATER # 2S PRESSURE	psia	P6.V.A0212	9.1	9.1	9.2	9.2	9.1
HEATER # 2S DRAIN TEMP	°F	P6.V.A0213	170.6	170.3	169.7	169.8	169.6
HEATER # 2S CNDS OUT TEMP	°F	P6.V.A0217	204.5	204.5	204.6	204.7	204.3
HEATER # 2S CNDS IN TEMP	°F	P6.V.A0218	151.7	151.6	151.5	151.5	151.3
LP TURB 16 IN EXTR TEMP	°F	P6.V.A0220	386.6	388.5	391.5	393.3	393.4
HEATER # 2N STEAM TEMP	°F	P6.V.A0221	379.4	381.2	384.2	385.8	386.0
HEATER # 2N PRESSURE	psia	P6.V.A0222	16.0	16.0	16.0	16.1	15.9

			400MW - Baseline	400 MW- 5%	400MW - 10%	400 MW - 15%	400MW - 20%
			10/24/06 8:21	10/24/06 10:50	10/24/06 13:25	10/24/06 15:30	10/24/06 17:32
			10/24/06 9:40	10/24/06 12:05	10/24/06 14:32	10/24/06 16:45	10/24/06 18:40
Test Measurements							
	Units	**TAG # (Source)**					
TEST DESCRIPTION							
Percent Biodiesel	%		0%	5%	10%	15%	20%
Generator Load (MWnet)	MWnet	P6.V.C002NET	403.68	404.78	404.74	406.50	401.99
Generator Load (MWG)	MWG	P6.V.A0001	419.30	420.09	420.04	421.82	417.33
HEATER # 2N DRAIN TEMP	°F	P6.V.A0223	154.2	154.6	155.6	156.2	154.6
HEATER # 2N CNDS OUT TEMP	°F	P6.V.A0227	204.4	204.4	204.7	205.0	204.2
HEATER # 2N CNDS IN TEMP	°F	P6.V.A0228	144.1	144.3	145.7	146.4	144.6
HTR # 3S SLP EXTR STM TEMP	°F	P6.V.A0310	488.3	490.3	493.6	495.8	496.0
HEATER # 3S STEAM TEMP	°F	P6.V.A0311	485.3	487.4	490.5	492.5	492.8
HEATER # 3S PRESSURE	psia	P6.V.A0312	14.5	14.5	14.4	14.5	14.2
HEATER # 3S DRAIN TEMP	°F	P6.V.A0313	225.5	226.0	226.5	226.5	226.2
HEATER # 3S CNDS OUT TEMP	°F	P6.V.A0317	248.1	248.1	248.1	248.2	247.6
HTR # 3N SLP EXTR STM TEMP	°F	P6.V.A0320	488.7	491.8	496.0	498.6	499.1
HEATER # 3N STEAM TEMP	°F	P6.V.A0321	486.1	488.9	492.5	494.8	495.0
HEATER # 3N PRESSURE	psia	P6.V.A0322	21.0	21.1	21.3	21.3	20.9
HEATER # 3N DRAIN TEMP	°F	P6.V.A0323	230.4	230.4	230.7	230.7	229.9
HEATER # 3N CNDS OUT TEMP	°F	P6.V.A0327	246.9	247.0	246.9	247.1	246.5
HTR # 4S NLP EXTR STM TEMP	°F	P6.V.A0410	625.2	627.1	630.2	632.4	632.4
HEATER # 4S STEAM TEMP	°F	P6.V.A0411	622.0	623.8	627.1	629.1	629.1
HEATER # 4S PRESSURE	psia	P6.V.A0412	47.6	47.6	47.5	47.7	47.2
HEATER # 4S DRAIN TEMP	°F	P6.V.A0413	250.2	250.1	249.9	250.1	249.5
HTR 4S CNDS OUT TEMP	°F	P6.V.A0417	288.3	288.3	288.4	288.5	287.8
HTR # 4N NLP EXTR STM TEMP	°F	P6.V.A0420	616.6	618.2	621.2	623.2	623.2
HTR 4N STM TEMP	°F	P6.V.A0421	612.6	614.3	617.3	619.3	619.2
HEATER # 4N PRESSURE	psia	P6.V.A0422	41.3	41.3	41.2	41.3	40.9
HTR 4N DRN TEMP	°F	P6.V.A0423	251.8	251.8	251.6	251.7	251.1
HTR 4N CNDS OUT TEMP	°F	P6.V.A0427	287.7	287.7	287.8	287.9	287.3
IP TURB 16 IN EXTR TEMP	°F	P6.V.A0500	693.9	695.3	698.9	701.2	701.1
IP TURB 16 IN EXTR TEMP	°F	P6.V.A0501	705.9	707.6	710.9	713.1	712.9
HTR 5S STEAM TEMP	°F	P6.V.A0511	695.5	697.3	700.8	702.5	702.8
HTR 5S STEAM PRESS	psia	P6.V.A0512	105.2	105.2	105.1	105.4	104.5
HEATER # 5S DRAIN TEMP	°F	P6.V.A0513	299.6	299.6	299.6	299.7	299.0
HTR 5S CNDS OUT TEMP	°F	P6.V.A0517	330.4	330.4	330.4	330.7	329.8
HEATER # 5N STEAM TEMP	°F	P6.V.A0521	695.5	697.4	700.7	702.6	702.8
HTR 5N STEAM PRESS	psia	P6.V.A0522	101.8	101.8	101.6	101.9	101.0
HEATER # 5N DRAIN TEMP	°F	P6.V.A0523	301.2	301.1	301.0	301.1	300.4
HTR 5N CNDS OUT TEMP	°F	P6.V.A0527	330.8	330.9	330.7	330.8	330.5
COND BEFORE BYP TEMP	°F	P6.V.A0528	333.0	333.0	333.0	333.2	332.4
COND AFTER BYP TEMP	°F	P6.V.A0529	331.6	331.7	331.6	331.9	331.1
HDP #1 SUCTION FLOW DP	inH2Og	P6.V.A0552	75.6	73.9	73.4	73.6	71.9
HDP #2 SUCTION FLOW DP	inH2Og	P6.V.A0562	2.6	2.6	2.6	2.6	2.6
IP TURB 14 IN EXTR TEMP	°F	P6.V.A0600	897.5	899.9	903.5	905.9	906.2
HTRS 6 STEAM TEMP	°F	P6.V.A0603	897.8	900.1	903.7	906.4	906.4
HTR 6S STEAM PRESS	psia	P6.V.A0612	188.0	188.0	187.8	188.4	186.6
HTR 6S DRN TEMP	°F	P6.V.A0613	333.0	333.1	333.0	333.1	332.5
HTR 6S CNDS OUT TEMP	°F	P6.V.A0615	390.3	390.4	390.5	390.7	389.8
HTR 6S CNDS IN TEMP	°F	P6.V.A0616	317.7	316.1	313.6	313.8	313.2
HEATER # 6N PRESSURE	psia	P6.V.A0622	183.3	183.3	183.1	183.7	182.0
HTR 6N DRN TEMP	°F	P6.V.A0623	332.7	332.7	332.8	332.9	332.0
HTR 6N CNDS OUT TEMP	°F	P6.V.A0625	381.3	379.6	376.8	377.2	376.7
HTR 6N CNDS IN	°F	P6.V.A0626	328.7	328.7	328.7	329.0	328.2
HTRS 7 EXTR TEMP	°F	P6.V.A0703	691.2	692.5	695.8	696.8	697.8

			400MW - Baseline	400 MW- 5%	400MW - 10%	400 MW - 15%	400MW - 20%
			10/24/06 8:21	10/24/06 10:50	10/24/06 13:25	10/24/06 15:30	10/24/06 17:32
			10/24/06 9:40	10/24/06 12:05	10/24/06 14:32	10/24/06 16:45	10/24/06 18:40
Test Measurements							
	Units	**TAG # (Source)**					
TEST DESCRIPTION							
Percent Biodiesel	%		0%	5%	10%	15%	20%
Generator Load (MWnet)	MWnet	P6.V.C002NET	403.68	404.78	404.74	406.50	401.99
Generator Load (MWG)	MWG	P6.V.A0001	419.30	420.09	420.04	421.82	417.33
HTR # 7S STEAM PRESS	psia	P6.V.A0712	357.5	357.4	356.8	358.0	354.6
HTR 7S DRN TEMP	°F	P6.V.A0713	433.8	433.6	433.5	433.6	432.7
HTR # 7S DRAIN FLOW DP	inH2Og	P6.V.A0714	95.9	100.3	93.6	97.1	88.1
HTR 7S CNDS OUT TEMP	°F	P6.V.A0715	437.8	437.8	437.7	437.8	437.2
HTR 7N STEAM PRESS	psia	P6.V.A0722	358.8	358.6	358.1	359.3	355.8
HTR 7 N DRN TEMP	°F	P6.V.A0723	433.5	433.5	433.4	433.4	432.6
HTR # 7N DRAIN FLOW DP	inH2Og	P6.V.A0724	53.3	51.8	50.2	50.6	48.9
HTR 7N CNDS OUT TEMP	°F	P6.V.A0725	437.0	437.0	436.8	437.2	436.4
FW PRESS INLET ORIF	psig	P6.V.A0801	1,106.1	1,058.2	1,080.4	1,108.9	1,102.9
FW TEMP INLT ORIF	°F	P6.V.A0802	434.8	434.9	434.8	435.1	434.1
FW TEMP INLT ECON	°F	P6.V.A0803	438.9	438.9	439.0	439.1	438.1
FW PRES INLT ECON	psig	P6.V.A0804	1,206.1	1,205.1	1,203.8	1,208.3	1,197.2
FEEDWATER FLO HI RANGE-A-CFX20	inH2Oa	P6.V.A0810	137.6	136.7	135.7	136.1	133.4
FEEDWTR FLO HI RANGE-B-FX201	inH2Oa	P6.V.A0811	112.2	111.2	110.1	109.9	107.6
Fans and Dampers							
FD Fan Amps 61	AMPS	P6.V.A1406	233.7	232.5	230.8	231.2	230.2
FD Fan Amps 62	AMPS	P6.V.A2406	266.1	264.7	264.0	264.1	263.2
AD Fan Amps 61	AMPS	P6.V.A1436	(0.2)	(0.3)	(0.2)	(0.3)	(0.4)
AD Fan Amps 62	AMPS	P6.V.A2436	243.1	241.9	244.3	243.7	243.0
AD 61 Fan Damper	%	P6.V.A1434	0.5	0.4	0.4	0.4	0.4
AD 62 Fan Damper	%	P6.V.A2434	0.1	0.1	0.2	0.2	0.2
ID Fan Amps 61	AMPS	P6.V.A1456	259.5	256.8	254.5	255.6	253.3
ID Fan Amps 62	AMPS	P6.V.A2456	-	-	-	-	-
ID Fan Amps 63	AMPS	P6.V.A3456	213.3	212.7	210.8	210.2	209.0
Tube Metal Temps							
NORTH DIV WALL TUBE TEMPS	°F	AVERAGE	779.2	779.1	778.3	778.8	778.6
SOUTH DIV WALL TUBE TEMPS	°F	AVERAGE	777.4	776.9	780.5	780.8	781.1
FSH METAL TEMPS	°F	AVERAGE	985.4	985.8	988.7	992.4	992.3

			750 MW Baseline	750 MW - 5%	750 MW - 10%	750 MW - 10%	750 MW 15%	750 MW - 20% (low O2, ID Fan put in manual)	750 MW - 20% (ID Fan in Automatic)	750 MW repeat Baseline - low O2	750 MW repeat Baseline - (ID fan in Automatic)
			10/25/06 8:40	10/25/06 10:40	10/25/06 13:45	10/25/06 14:32	10/25/06 15:30	10/25/06 17:09	10/25/06 17:58	10/25/06 19:53	10/25/06 20:30
			10/25/06 9:50	10/25/06 12:29	10/25/06 14:06	10/25/06 14:58	10/25/06 16:36	10/25/06 17:32	10/25/06 19:03	10/25/06 20:13	10/25/06 20:50
Test Measurements											
	Units	**TAG # (Source)**									
TEST DESCRIPTION											
Percent Biodiesel	%		0%	5%	10%	10%	15%	20%	20%	0%	0%
Generator Load (MWnet)	MWnet	P6.V.C002NET	755.55	752.93	754.89	754.04	752.47	754.61	752.80	753.14	752.54
Generator Load (MWG)	MWG	P6.V.A0001	784.63	781.83	783.69	783.76	782.36	783.19	782.80	781.77	782.13
Auxially Load	MWaux	P6.V.A1314	28.99	29.01	28.39	29.73	29.88	28.53	30.09	28.62	29.81
Fuel Heating Value (from analysis)	Btu/gal	Lab analysis	150,000	148,890	148,110	148,110	146,590	145,010	145,010	150,000	150,000
Plant Heat Rate	Btu/kWhr	Calculation	10,538	10,573	10,493	10,510	10,456	10,365	10,424	10,469	10,518
Excess Air (% O2 dry) AH Inlet	% dry	TRC Solutions	3.55%	3.70%	3.35%	3.95%	3.95%	4.20%	4.05%	not taken	not taken
Dilution Air (%)	%	From Chart									
Overfire Air Ports	% open		10%	10%	10%	10%	10%	10%	10%	10%	10%
Burners Out of Service			4 pair	4 pair	4 pair	4 pair	4 pair	4 pair	4 pair	4 pair	4 pair
Fuel and Burner Info											
BIODIESEL FLOW	GPM	Manual Measurement	-	45.0	88.0	88.0	132.0	176.0	176.0	-	-
FUEL OIL FLOW TO HEADER	GPM	CALCULATION	884.6	891.1	891.3	891.8	894.5	899.0	901.9	876.1	879.5
FUEL OIL FLOW TO HDR - CFX2671	GPM	P6.V.A1500	884.63	894.08	895.06	895.07	897.27	901.15	902.03	878.25	881.66
FUEL OIL FLOW TO HDR - FX2670	GPM	P6.V.A1501	869.56	875.56	876.44	876.41	878.18	882.04	883.25	863.48	867.73
FO RETURN FLOW METER - CFX2674	GPM	MANUAL	0.00	3.00	3.74	3.28	2.73	2.18	0.16	2.18	2.18
FO HEADER RETURN TEMP		P6.V.A1571	188.24	179.52	172.12	170.93	162.04	154.40	152.39	171.15	184.84
FUEL OIL TEMPERATURE (at Meter)	deg. F	P6.V.A1541	196.56	182.29	173.25	173.46	157.75	148.48	149.51	198.24	198.93
FUEL OIL TO HEATERS TEMP	°F	P6.V.A1510	128.34	124.08	120.03	119.95	116.88	113.59	114.39	123.39	124.55
HEAT ABSORBED BY FUEL OIL	MMBTU/HR	CALCULATION	11.9	10.2	9.3	9.4	7.2	6.2	6.2	12.9	12.9
FUEL OIL PRESSURE	psig	P6.V.A1531	291.36	289.22	287.82	288.00	287.57	285.67	285.78	288.94	289.95
ATOMIZING STEAM PRESS	psig	P6.V.A1590	169.37	169.11	168.87	168.88	168.56	168.08	167.80	168.89	168.77
ATOMIZING STEAM FLOW	lb/hr	P6.V.C1591	11753.77	12064.46	12297.17	12290.01	12566.53	12780.96	12762.41	11755.97	11732.77
ATOMIZING STEAM TEMP	deg. F	P6.V.A1589	378.94	378.82	378.74	378.73	378.38	378.21	378.04	378.70	378.58
FUEL OIL SUPPLY PRESS	psig	P6.V.A1509	600.92	609.29	612.79	612.91	613.86	614.22	614.19	596.07	596.59
FO HTR STEAM PRESS # 1	psig	P6.V.A1511	97.70	63.18	46.58	46.48	24.73	16.75	16.86	101.29	100.29
FO HEATER # 1 STEAM TEMP	°F	P6.V.A1512	344.94	330.86	322.90	322.94	308.71	301.80	301.70	346.89	346.39
FO HEATER # 1 DRAIN TEMP	°F	P6.V.A1513	270.86	251.17	239.35	239.95	216.50	202.34	203.89	289.80	292.68
FO HTR DRN COOLER # 1 TEMP	°F	P6.V.A1514	150.05	140.55	133.94	133.80	124.98	118.96	119.64	151.04	152.67
FO OUT DRN CLR # 1 TEMP	°F	P6.V.A1515	134.03	128.19	124.45	124.20	120.15	116.56	117.39	130.20	131.59
FUEL OIL OUTL HTR # 1 TEMP	°F	P6.V.A1516	194.15	179.76	170.76	170.75	154.96	145.90	147.16	196.01	196.67
FUEL OIL FROM HEATERS	°F	P6.V.A1517	194.74	180.65	171.87	171.87	155.90	146.41	147.66	196.55	197.25
FO HTR STM PRESS # 2	psig	P6.V.A1521	-0.57	-0.57	-0.51	-0.52	-0.53	-0.60	-0.55	-0.63	-0.68
FO HEATER # 2 STEAM TEMP	°F	P6.V.A1522	103.81	106.65	108.84	108.99	109.07	108.85	108.23	107.85	108.04
FO HEATER # 2 DRAIN TEMP	°F	P6.V.A1523	65.35	66.58	68.58	69.29	69.92	70.11	70.02	69.06	68.96
FO HTR DRN COOLER # 2 TEMP	°F	P6.V.A1524	67.08	66.96	67.50	67.83	68.22	68.63	68.74	68.70	68.66
FO OUT DRN CLR # 2 TEMP	°F	P6.V.A1525	69.50	69.39	69.91	69.93	70.03	70.15	70.36	70.02	69.98
FUEL OIL OUTL HTR # 2 TEMP	°F	P6.V.A1526	139.80	139.71	139.55	139.54	139.58	139.95	139.74	139.84	139.86
OIL BURNER HDR PRES - 3 - PX2670	psig	P6.V.A1531	291.36	289.22	287.82	288.00	287.57	285.67	285.78	288.94	289.95
FO HEADER PRES LOWER	psig	P6.V.A1532	287.43	285.00	283.24	283.54	282.79	280.86	281.04	284.97	285.89
FO HEADR PRES CENTER	psig	P6.V.A1533	284.42	282.30	280.92	280.97	280.24	278.41	278.50	281.88	282.88
FUEL OIL HEADER TEMP	°F	P6.V.A1541	196.56	182.29	173.25	173.46	157.75	148.48	149.51	198.24	198.93
FUEL OIL HEADER TEMP - UPPER	°F	P6.V.A1542	194.54	180.75	172.21	172.19	156.72	147.00	148.36	196.33	197.12
FUEL OIL HEADER TEMP - LOWER	°F	P6.V.A1543	194.56	180.85	172.22	172.12	156.66	147.29	148.57	196.23	197.09
FO HEADER TEMP - MIDDLE	°F	P6.V.A1544	194.45	180.93	172.39	172.49	156.60	147.33	148.42	196.25	196.95

			750 MW Baseline	750 MW - 5%	750 MW - 10%	750 MW - 10%	750 MW 15%	750 MW - 20% (low O2, ID Fan put in manual)	750 MW - 20% (ID Fan in Automatic)	750 MW repeat Baseline - low O2	750 MW repeat Baseline - (ID fan in Automatic)
			10/25/06 8:40	10/25/06 10:40	10/25/06 13:45	10/25/06 14:32	10/25/06 15:30	10/25/06 17:09	10/25/06 17:58	10/25/06 19:53	10/25/06 20:30
			10/25/06 9:50	10/25/06 12:29	10/25/06 14:06	10/25/06 14:58	10/25/06 16:36	10/25/06 17:32	10/25/06 19:03	10/25/06 20:13	10/25/06 20:50
Test Measurements											
	Units	**TAG # (Source)**									
TEST DESCRIPTION											
Percent Biodiesel	%		0%	5%	10%	10%	15%	20%	20%	0%	0%
Generator Load (MWnet)	MWnet	P6.V.C002NET	755.55	752.93	754.89	754.04	752.47	754.61	752.80	753.14	752.54
Generator Load (MWG)	MWG	P6.V.A0001	784.63	781.83	783.69	783.76	782.36	783.19	782.80	781.77	782.13
FO HEADER RETURN TEMP	°F	P6.V.A1571	188.24	179.52	172.12	170.93	162.04	154.40	152.39	171.15	184.84
FO SYSTEM RETURN TEMP	°F	P6.V.A1572	131.42	132.49	124.05	123.52	120.90	120.18	117.70	124.76	125.45
FUEL FORWARDING PUMPS											
FUEL FWD PUMP A											
A MOTOR AMPS	AMPS	Manual	O/S	O/S	O/S	O/S	O/S	O/S	O/S	O/S	O/S
A INLET PRESSURE	psig	Manual	O/S	O/S	O/S	O/S	O/S	O/S	O/S	O/S	O/S
A OUTLET TEMPERATURE	°F	Manual	O/S	O/S	O/S	O/S	O/S	O/S	O/S	O/S	O/S
FUEL FWD PUMP B											
B MOTOR AMPS	AMPS	Manual	21.75	21.50	20.50	20.50	20.00	19.00	19.00	21.75	21.75
B INLET PRESSURE	psig	Manual	5.50	5.50	5.00	5.00	4.50	4.50	4.50	5.50	5.50
B OUTLET TEMPERATURE	°F	Manual	118.50	117.00	114.00	114.00	110.00	108.00	108.00	118.50	118.50
FUEL FWD PUMP C											
C MOTOR AMPS	AMPS	Manual	22.00	21.50	20.50	20.50	20.00	19.50	19.50	22.00	22.00
C INLET PRESSURE	psig	Manual	5.00	5.00	4.50	4.50	4.50	4.50	4.50	5.00	5.00
C OUTLET TEMPERATURE	°F	Manual	118.50	117.00	114.00	114.00	110.00	108.00	108.00	118.50	118.50
Air Flow											
Temperatures											
Ambient Air Temperature	deg. F										
AH1 Inlet Air Temperature (average)	deg. F	average	101.29	103.51	105.28	105.65	105.54	105.87	104.87	103.89	103.73
AH2 Inlet Air Temperature (average)	deg. F	average	98.27	100.50	102.17	102.47	102.50	102.56	101.73	100.86	100.76
AH1 Outlet Air Temperature (average)	deg. F	average	579.28	580.67	581.24	581.06	581.67	582.09	581.89	582.01	581.39
AH2 Outlet Air Temperature (average)	deg. F	average	554.68	555.30	558.36	557.04	557.64	559.12	557.94	558.41	556.61
North Dil Air Outlet - Mixture Temp	deg. F	average	583.08	583.48	585.93	584.82	585.33	586.74	585.61	586.39	584.87
South Dil Air Outlet - Mixture Temp	deg. F	average	588.70	589.59	591.22	590.71	591.45	592.30	591.65	592.26	591.97
Windbox Temperature	deg. F	average	585.89	586.53	588.58	587.76	588.39	589.52	588.63	589.33	588.42
Pressures											
Air Heater Inlet Air pressure	in. WC										
Air Heat Outlet Air pressure	in. WC										
Dilution Air pressure	in. WC										
Windbox pressure	in. WC										
FURNACE DRAFT - A -CPX36	inH2Oa	P6.V.A2330	-0.50	-0.45	-0.63	-0.51	-0.54	-0.67	-0.47	-0.54	-0.40
FURNACE DRAFT 1 - B - PX361	inH2Oa	P6.V.A1330	-0.52	-0.46	-0.65	-0.52	-0.56	-0.69	-0.49	-0.56	-0.42
IDF 61 SUCTION - CPX 3911	inH2Oa	P6.V.A1150	-16.62	-15.95	-15.96	-16.61	-16.99	-16.89	-18.12	-18.78	-19.24
IDF 62 SUCTION - CPX3921	inH2Oa	P6.V.A2150	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
IDF 63 SUCTION - CPX3931	inH2Oa	P6.V.A3150	-19.79	-19.85	-19.05	-20.26	-20.48	-19.38	-20.64	-19.30	-20.28
Gas Flow											
Temperatures											
Furnace Exit Gas Temperature	deg. F	TRC Solutions	2055	2030	2064	no data	2043	no data	2025	no data	no data
Average AH1 Inlet Gas Temperature	deg. F	calc	681.98	684.65	682.97	686.75	687.81	685.55	689.55	687.22	689.89
Average AH2 Inlet Gas Temperature	deg. F	calc	676.94	674.72	674.12	675.77	675.01	673.63	678.35	673.70	668.76
Average AH1 Outlet Gas Temperature	deg. F	calc	298.24	300.42	302.42	302.97	303.99	304.12	304.15	302.92	302.60
Average AH2 Outlet Gas Temperature	deg. F	calc.	284.42	286.23	289.31	289.39	290.37	290.92	290.66	289.38	288.54

			750 MW Baseline	750 MW - 5%	750 MW - 10%	750 MW - 10%	750 MW 15%	750 MW - 20% (low O2, ID Fan put in manual)	750 MW - 20% (ID Fan in Automatic)	750 MW repeat Baseline - low O2	750 MW repeat Baseline - (ID fan in Automatic)
			10/25/06 8:40	10/25/06 10:40	10/25/06 13:45	10/25/06 14:32	10/25/06 15:30	10/25/06 17:09	10/25/06 17:58	10/25/06 19:53	10/25/06 20:30
			10/25/06 9:50	10/25/06 12:29	10/25/06 14:06	10/25/06 14:58	10/25/06 16:36	10/25/06 17:32	10/25/06 19:03	10/25/06 20:13	10/25/06 20:50
Test Measurements											
	Units	**TAG # (Source)**									
TEST DESCRIPTION											
Percent Biodiesel	%		0%	5%	10%	10%	15%	20%	20%	0%	0%
Generator Load (MWnet)	MWnet	P6.V.C002NET	755.55	752.93	754.89	754.04	752.47	754.61	752.80	753.14	752.54
Generator Load (MWG)	MWG	P6.V.A0001	784.63	781.83	783.69	783.76	782.36	783.19	782.80	781.77	782.13
Gas Pressures and Damper Positions											
Airheater Inlet Gas Pressure	in. WC										
Airheater Outlet Gas Pressure	in. WC										
SH PASS DMPR 1 POSN - PD101711	%	P6.V.A2380	99.23	99.22	99.12	99.07	99.24	99.24	99.22	99.25	99.24
SH PASS DMPR DRV 2 - PD101721	%	P6.V.A2381	96.71	96.64	96.57	96.54	96.51	96.49	96.50	96.54	96.55
SH PASS DMPR DRV 3 - PD101731	%	P6.V.A2382	-25.00	-25.00	-25.00	-25.00	-25.00	-25.00	-25.00	-25.00	-25.00
SH PASS DMPR 4 POSN - PD101741	%	P6.V.A2383	98.91	98.83	98.84	98.77	98.81	98.84	98.83	98.87	98.90
SH PASS DMPR DRV 5 - PD101751	%	P6.V.A2384	99.45	99.47	99.47	99.48	99.48	99.48	99.51	99.48	99.48
SH PASS DMPR DRV 6 - PD101761	%	P6.V.A2385	99.95	99.97	100.03	100.02	100.01	99.95	100.01	99.91	99.88
RH PASS DMPR 1 POSN - PD05011	%	P6.V.A1380	16.10	18.10	17.10	16.75	16.71	16.69	16.70	16.71	16.72
RH PASS DMPR DRV 2 - PD05021	%	P6.V.A1381	16.33	18.41	17.31	16.94	16.83	16.87	16.90	16.81	16.79
RH PASS DMPR DRV 3 - PDO5031	%	P6.V.A1382	19.01	19.90	18.89	18.49	18.53	18.54	18.53	18.54	18.52
RH PASS DMPR 4 POSN - PDO5041	%	P6.V.A1383	17.95	19.02	17.91	17.51	17.51	17.51	17.50	17.49	17.49
RH PASS DMPR 5 POSN - PD05051	%	P6.V.A1384	20.09	20.12	19.09	18.58	18.61	18.59	18.62	18.58	18.56
RH PASS DMPR DRV 6 - PD05061	%	P6.V.A1385	21.56	21.22	19.97	19.56	19.57	19.46	19.44	19.41	19.39
ID Fan Inlet Gas Pressure	in. WC										
ID Fan Outlet Gas Pressure	in. WC										
Test Measurements (continued)											
Emissions											
Windbox % O2 (North)	%	TRC Solutions	18.9	18.9	no data	18.9	18.9	18.8	19.0	no data	no data
Windbox % O2 (South)	%	TRC Solutions	18.8	18.9	no data	18.9	18.8	18.7	18.9	no data	no data
Air Heater Inlet %O2 (North)	%	TRC Solutions	4.2	4.3	3.7	4.6	4.5	4.2	4.8	no data	no data
Air Heater Inlet %O2 (South)	%	TRC Solutions	2.9	3.1	3.0	3.3	3.4	no data	3.3	no data	no data
CEMS NOx	ppm dry	CEMS DATA	135.1	139.5	112.9	137.9	139.7	113.4	143.0	123.5	147.4
CEMS OPACITY	%	CEMS DATA	7.0	5.9	8.7	5.6	5.5	7.5	5.4	7.1	6.0
CEMS O2	%	CEMS DATA	3.97	4.04	3.46	4.09	4.18	3.65	4.26	3.65	4.15
STACK O2	%	TRC Solutions	4.7	4.9	4.2	4.9	5.0	4.4	5.1	4.4	4.9
STACK OPACITY	%	TRC Solutions	4.8	4.7	4.8	no data	no data	no data	1.5	no data	no data
STACK NOx	lb/MMBtu	TRC Solutions	0.206	0.220	0.165	0.211	0.213	0.167	0.221	0.184	0.226
STACK CO	ppm	TRC Solutions	118.6	73.9	463.1	63.0	64.5	404.0	42.1	320.2	60.2
STACK CO	lb/MMBtu	TRC Solutions	0.1040	0.066	0.392	0.056	0.057	0.343	0.037	0.278	0.054
STACK PM10	lb/MMBtu	TRC Solutions	0.0173	0.0164	no data	no data	0.0183	no data	0.0170	no data	no data
STACK SO2	lb/MMBtu	TRC Solutions	0.311	0.295	0.282	0.277	0.264	0.255	0.250	0.312	0.314
STACK CO	lb/mw-hr		1.096	0.698	4.113	0.589	0.596	3.555	0.386	2.910	0.568
STACK PM10	lb/mw-hr		0.182	0.173			0.191		0.177		
STACK SO2	lb/mw-hr		3.277	3.119	2.959	2.911	2.760	2.643	2.606	3.266	3.303
STACK NOx	lb/mw-hr		2.171	2.326	1.731	2.218	2.227	1.731	2.304	1.926	2.377
Steam											
MS Flow	klbs/hr	Calculated (FW + Spray)									
MAIN STEAM FLOW	kPPH	P6.V.C4000	5,550.9	5,515.2	5,505.6	5,528.7	5,521.3	5,504.7	5,526.4	5,500.9	5,520.2
MAIN STEAM BLR OUTL PRESS	psig	P6.V.A4000	2,181.3	2,169.7	2,171.5	2,175.0	2,170.5	2,169.2	2,171.2	2,166.3	2,169.2
MAIN STEAM TEMP	°F	P6.V.A0960	628.0	628.0	628.0	628.0	628.0	628.0	628.0	628.0	628.0
MAIN STM FSH OUTLET AVG TEMP	°F	P6.V.C4001	966.7	968.2	976.6	969.6	968.7	976.4	967.9	974.1	967.1

			750 MW Baseline	750 MW - 5%	750 MW - 10%	750 MW - 10%	750 MW 15%	750 MW - 20% (low O2, ID Fan put in manual)	750 MW - 20% (ID Fan in Automatic)	750 MW repeat Baseline - low O2	750 MW repeat Baseline - (ID fan in Automatic)
			10/25/06 8:40	10/25/06 10:40	10/25/06 13:45	10/25/06 14:32	10/25/06 15:30	10/25/06 17:09	10/25/06 17:58	10/25/06 19:53	10/25/06 20:30
			10/25/06 9:50	10/25/06 12:29	10/25/06 14:06	10/25/06 14:58	10/25/06 16:36	10/25/06 17:32	10/25/06 19:03	10/25/06 20:13	10/25/06 20:50
Test Measurements											
	Units	**TAG # (Source)**									
TEST DESCRIPTION											
Percent Biodiesel	%		0%	5%	10%	10%	15%	20%	20%	0%	0%
Generator Load (MWnet)	MWnet	P6.V.C002NET	755.55	752.93	754.89	754.04	752.47	754.61	752.80	753.14	752.54
Generator Load (MWG)	MWG	P6.V.A0001	784.63	781.83	783.69	783.76	782.36	783.19	782.80	781.77	782.13
MN STM FSH OUT NE GMC TEMP	°F	P6.V.A4003	500.0	500.0	500.0	500.0	500.0	500.0	500.0	500.0	500.0
MN STM FSH OUT SW GMC TEMP	°F	P6.V.A4004	500.0	500.0	500.0	500.0	500.0	500.0	500.0	500.0	500.0
MN STM FSH OUTL N-E TEMP	°F	P6.V.A4001	967.4	968.8	977.3	970.1	969.2	976.8	968.3	974.8	967.8
MN STM FSH OUTL S-W TEMP	°F	P6.V.A4002	966.1	967.7	976.1	969.0	968.3	975.9	967.5	973.5	966.4
Lwr SH Spray Flow	MPPH	P6.V.C0872	404.3	396.4	362.4	425.0	422.6	425.0	392.4	425.0	425.0
Lwr SH Spray Flow Xmitter dP	inH2Oa	P6.V.CFX1024S	16.671	15.416	14.697	13.326	13.567	14.526	13.336	15.236	14.651
Uppr SH Spray Flow	MPPH	P6.V.C0882	17.6	19.9	21.0	21.2	21.1	20.9	20.3	19.4	19.0
Uppr SH Spray Flow Xmitter dP	inH2Oa	P6.V.CFX1034S	0.170	0.214	0.243	0.245	0.244	0.236	0.227	0.213	0.200
SH SPRAY WATER TEMP	°F	P6.V.A0870	499.3	498.8	498.9	499.0	498.8	498.8	498.9	498.8	498.6
SH SPRAY WATER PRESS	psig	P6.V.A0871	2,360.1	2,347.5	2,346.6	2,351.4	2,346.7	2,343.0	2,347.4	2,340.9	2,345.8
DRUM # 1 PRESSURE - CPX011	psig	P6.V.A0908	2,383.4	2,370.7	2,372.3	2,377.7	2,373.2	2,371.1	2,374.8	2,368.0	2,372.3
DRUM # 2 PRESSURE - CPX012	psig	P6.V.A0909	2,377.7	2,365.7	2,368.0	2,374.0	2,369.7	2,367.9	2,371.7	2,365.2	2,369.0
COLD RH - DESUP INLT TEMP	°F	P6.V.A0980	667.6	669.7	676.7	671.1	670.2	676.4	669.9	674.5	669.2
COLD RH - DESUP OUTL TEMP	°F	P6.V.A0981	665.6	667.3	674.1	669.0	667.8	674.1	667.5	672.1	666.9
COLD RH - DESUP OUTL TEMP	°F	P6.V.A0982	667.0	667.0	667.0	667.0	667.0	667.0	667.0	667.0	667.0
CRH Steam Flow	klb/hr										
AVERAGE HOT REHEAT TEMP	deg. F	P6.V.C005HRHT	1,004.8	1,008.5	1,013.0	1,008.1	1,007.3	1,012.1	1,007.4	1,012.5	1,009.6
HOT RH PRESS AT TURB	psig	P6.V.A4202	608.2	605.3	604.8	606.4	605.7	604.7	606.3	603.5	605.4
RH SPRAY FLOW RATE	lb/h	P6.V.C0892	554,875.2	564,432.6	572,239.1	573,874.9	575,252.3	576,382.9	575,914.8	573,036.0	572,164.8
RH STEAM FLOW	klb/hr	P6.V.C209RHF	5,038.9	5,001.3	4,988.0	5,004.8	4,999.4	4,987.7	5,008.1	4,992.0	5,008.5
HRH Steam Temperature	deg. F										
HRH Steam Pressure	psig										
Feedwater											
FW Flow	klbs/hr	P6.V.C0813	6,067.2	6,012.3	5,771.4	6,206.4	6,217.6	6,233.0	6,036.1	6,233.0	6,233.0
FW Flow Transmitter dP	inH2Oa	P6.V.CFX20S	503.4	498.7	495.9	504.5	502.6	496.1	504.1	495.4	500.1
FW Temperature	deg. F	P6.V.A0803	499.6	499.1	499.3	499.5	499.3	499.2	499.2	499.1	499.1
FW Pressure	psig	P6.V.A0804	2,318.7	2,307.9	2,310.4	2,316.4	2,312.9	2,310.2	2,314.9	2,308.3	2,312.4
HEATER # 1S STEAM TEMP	°F	P6.V.A0111	174.1	173.8	173.8	173.8	173.7	173.4	173.4	173.4	173.4
HEATER # 1S PRESURE	psia	P6.V.A0112	11.2	11.2	11.2	11.1	11.1	11.1	11.1	11.1	11.1
HEATER # 1S DRAIN TEMP	°F	P6.V.A0113	111.9	111.7	112.5	111.2	110.8	110.6	110.1	110.2	110.3
HEATER # 1S CNDS OUT TEMP	°F	P6.V.A0117	173.0	172.8	172.9	172.8	172.7	172.4	172.3	172.2	172.4
HEATER # 1S CNDS IN TEMP	°F	P6.V.A0118	103.0	102.9	104.0	102.4	102.2	101.5	101.0	101.3	101.2
HEATER # 1N STEAM TEMP	°F	P6.V.A0121	176.9	177.0	176.8	176.9	176.7	176.9	176.8	176.7	176.6
HEATER # 1N PRESSURE	psia	P6.V.A0122	8.9	8.9	8.9	8.9	8.9	8.9	8.9	8.9	8.9
HEATER # 1N DRAIN TEMP	°F	P6.V.A0123	111.3	110.9	111.8	110.4	110.1	109.7	109.0	109.6	109.4
HEATER # 1N CNDS OUT TEMP	°F	P6.V.A0127	175.5	175.5	175.9	175.7	175.5	175.2	175.2	175.5	175.4
HEATER # 1N CNDS IN TEMP	°F	P6.V.A0128	103.2	103.0	103.8	102.5	101.9	101.3	100.6	100.9	100.9
LP TURB 16 IN EXTR TEMP	°F	P6.V.A0210	311.8	316.2	321.6	315.7	314.3	318.1	313.7	318.0	316.5
HEATER # 2S STEAM TEMP	°F	P6.V.A0211	313.7	317.3	322.3	317.2	315.6	318.7	315.0	318.6	317.6
HEATER # 2S PRESSURE	psia	P6.V.A0212	21.6	21.5	21.5	21.6	21.5	21.5	21.5	21.5	21.5
HEATER # 2S DRAIN TEMP	°F	P6.V.A0213	186.4	184.7	183.7	183.4	182.8	182.9	182.8	183.2	183.3
HEATER # 2S CNDS OUT TEMP	°F	P6.V.A0217	232.8	232.4	232.4	232.6	232.4	232.4	232.3	232.3	232.3
HEATER # 2S CNDS IN TEMP	°F	P6.V.A0218	173.1	172.9	173.1	173.1	172.8	172.6	172.6	172.6	172.5
LP TURB 16 IN EXTR TEMP	°F	P6.V.A0220	344.5	349.0	354.6	349.5	347.5	351.5	347.2	351.3	350.0
HEATER # 2N STEAM TEMP	°F	P6.V.A0221	339.5	343.4	348.8	344.0	342.3	345.8	341.7	345.3	344.3

			750 MW Baseline	750 MW - 5%	750 MW - 10%	750 MW - 10%	750 MW 15%	750 MW - 20% (low O2, ID Fan put in manual)	750 MW - 20% (ID Fan in Automatic)	750 MW repeat Baseline - low O2	750 MW repeat Baseline - (ID fan in Automatic)
			10/25/06 8:40	10/25/06 10:40	10/25/06 13:45	10/25/06 14:32	10/25/06 15:30	10/25/06 17:09	10/25/06 17:58	10/25/06 19:53	10/25/06 20:30
			10/25/06 9:50	10/25/06 12:29	10/25/06 14:06	10/25/06 14:58	10/25/06 16:36	10/25/06 17:32	10/25/06 19:03	10/25/06 20:13	10/25/06 20:50
Test Measurements											
	Units	**TAG # (Source)**									
TEST DESCRIPTION											
Percent Biodiesel	%		0%	5%	10%	10%	15%	20%	20%	0%	0%
Generator Load (MWnet)	MWnet	P6.V.C002NET	755.55	752.93	754.89	754.04	752.47	754.61	752.80	753.14	752.54
Generator Load (MWG)	MWG	P6.V.A0001	784.63	781.83	783.69	783.76	782.36	783.19	782.80	781.77	782.13
HEATER # 2N PRESSURE	psia	P6.V.A0222	26.4	26.4	26.4	26.4	26.4	26.4	26.4	26.3	26.4
HEATER # 2N DRAIN TEMP	°F	P6.V.A0223	183.9	184.3	184.4	184.4	184.1	184.1	184.3	184.1	184.1
HEATER # 2N CNDS OUT TEMP	°F	P6.V.A0227	235.9	235.7	235.8	235.9	235.7	235.7	235.8	235.7	235.7
HEATER # 2N CNDS IN TEMP	°F	P6.V.A0228	174.6	175.0	175.3	174.8	174.8	174.6	174.7	174.8	174.7
HTR # 3S SLP EXTR STM TEMP	°F	P6.V.A0310	468.9	472.0	475.7	472.2	471.3	474.7	471.3	474.7	473.2
HEATER # 3S STEAM TEMP	°F	P6.V.A0311	467.3	470.5	474.0	470.9	470.0	473.1	470.0	473.1	471.9
HEATER # 3S PRESSURE	psia	P6.V.A0312	37.0	36.8	36.8	36.9	36.8	36.8	36.9	36.7	36.9
HEATER # 3S DRAIN TEMP	°F	P6.V.A0313	245.7	245.9	245.9	245.9	245.7	245.9	245.6	245.5	245.4
HEATER # 3S CNDS OUT TEMP	°F	P6.V.A0317	280.9	280.8	280.8	281.1	280.9	280.8	281.1	280.9	280.9
HTR # 3N SLP EXTR STM TEMP	°F	P6.V.A0320	465.6	468.6	472.3	469.0	468.0	471.2	468.2	471.2	470.0
HEATER # 3N STEAM TEMP	°F	P6.V.A0321	462.6	465.7	469.2	466.5	465.3	468.2	465.6	468.1	467.2
HEATER # 3N PRESSURE	psia	P6.V.A0322	42.4	42.3	42.3	42.4	42.4	42.3	42.4	42.2	42.3
HEATER # 3N DRAIN TEMP	°F	P6.V.A0323	258.0	258.3	258.2	257.9	258.1	258.2	258.0	258.0	258.2
HEATER # 3N CNDS OUT TEMP	°F	P6.V.A0327	280.4	280.3	280.4	280.4	280.3	280.4	280.5	280.4	280.2
HTR # 4S NLP EXTR STM TEMP	°F	P6.V.A0410	607.2	610.8	614.9	611.1	610.1	614.0	610.2	613.8	612.3
HEATER # 4S STEAM TEMP	°F	P6.V.A0411	604.8	608.1	612.2	608.6	607.4	611.2	607.6	611.0	609.9
HEATER # 4S PRESSURE	psia	P6.V.A0412	90.9	90.5	90.5	90.7	90.6	90.5	90.6	90.3	90.6
HEATER # 4S DRAIN TEMP	°F	P6.V.A0413	285.1	284.7	284.4	284.6	284.5	284.6	284.5	284.7	284.8
HTR 4S CNDS OUT TEMP	°F	P6.V.A0417	324.9	324.7	324.7	324.9	324.7	324.8	324.9	324.8	324.7
HTR # 4N NLP EXTR STM TEMP	°F	P6.V.A0420	601.5	605.2	608.9	605.2	604.4	608.2	604.7	608.4	606.5
HTR 4N STM TEMP	°F	P6.V.A0421	598.7	602.1	605.7	602.2	601.4	605.1	601.6	605.2	603.5
HEATER # 4N PRESSURE	psia	P6.V.A0422	84.3	84.0	83.9	84.1	84.0	83.9	84.1	83.8	84.0
HTR 4N DRN TEMP	°F	P6.V.A0423	287.9	287.7	287.6	287.7	287.5	287.5	287.9	287.8	287.9
HTR 4N CNDS OUT TEMP	°F	P6.V.A0427	324.7	324.5	324.4	324.7	324.5	324.6	324.6	324.4	324.5
IP TURB 16 IN EXTR TEMP	°F	P6.V.A0500	682.5	685.9	689.9	685.9	685.2	689.1	685.4	689.3	687.1
IP TURB 16 IN EXTR TEMP	°F	P6.V.A0501	691.6	694.7	698.5	694.7	694.0	697.8	694.2	697.9	696.0
HTR 5S STEAM TEMP	°F	P6.V.A0511	671.6	674.3	679.3	675.2	674.2	678.7	674.2	678.0	675.5
HTR 5S STEAM PRESS	psia	P6.V.A0512	186.5	185.7	185.6	186.1	185.8	185.6	186.0	185.3	185.9
HEATER # 5S DRAIN TEMP	°F	P6.V.A0513	342.8	342.3	342.2	342.5	342.4	342.1	342.4	342.4	342.2
HTR 5S CNDS OUT TEMP	°F	P6.V.A0517	372.1	371.9	371.8	372.0	371.9	371.9	372.1	372.0	371.9
HEATER # 5N STEAM TEMP	°F	P6.V.A0521	681.4	685.0	689.1	685.2	684.4	688.6	684.7	688.4	686.2
HTR 5N STEAM PRESS	psia	P6.V.A0522	183.4	182.7	182.5	183.0	182.7	182.5	182.9	182.3	182.8
HEATER # 5N DRAIN TEMP	°F	P6.V.A0523	345.8	345.8	345.7	345.9	345.8	345.7	345.9	345.9	345.8
HTR 5N CNDS OUT TEMP	°F	P6.V.A0527	373.7	373.9	374.0	373.9	373.8	373.8	374.0	374.0	373.7
COND BEFORE BYP TEMP	°F	P6.V.A0528	375.8	375.6	375.5	375.7	375.5	375.6	375.7	375.6	375.5
COND AFTER BYP TEMP	°F	P6.V.A0529	374.2	374.0	374.0	374.2	373.8	373.9	374.1	373.9	373.9
HDP #1 SUCTION FLOW DP	inH2Og	P6.V.A0552	96.0	94.4	93.8	94.6	94.9	94.4	95.8	95.9	96.0
HDP #2 SUCTION FLOW DP	inH2Og	P6.V.A0562	96.7	94.8	93.5	96.1	93.4	93.1	93.7	93.2	95.0
IP TURB 14 IN EXTR TEMP	°F	P6.V.A0600	889.5	893.0	897.1	893.3	892.3	896.3	892.7	896.5	894.5
HTRS 6 STEAM TEMP	°F	P6.V.A0603	890.1	893.7	897.9	894.1	893.2	897.0	893.4	897.1	895.3
HTR 6S STEAM PRESS	psia	P6.V.A0612	351.7	350.2	350.1	351.0	350.6	350.1	351.0	349.5	350.5
HTR 6S DRN TEMP	°F	P6.V.A0613	381.3	380.5	380.8	381.2	380.7	380.6	380.5	380.5	380.7
HTR 6S CNDS OUT TEMP	°F	P6.V.A0615	440.5	440.3	440.3	440.3	440.3	440.3	440.4	440.3	440.0
HTR 6S CNDS IN TEMP	°F	P6.V.A0616	355.6	355.3	354.0	353.7	353.4	353.0	353.3	353.5	353.2
HEATER # 6N PRESSURE	psia	P6.V.A0622	345.6	344.2	344.1	345.0	344.6	344.1	345.0	343.6	344.5
HTR 6N DRN TEMP	°F	P6.V.A0623	382.8	382.6	382.5	382.9	382.5	382.7	382.8	382.4	382.5
HTR 6N CNDS OUT TEMP	°F	P6.V.A0625	433.1	430.2	428.4	428.3	428.2	428.5	429.4	430.7	430.9

			750 MW Baseline	750 MW - 5%	750 MW - 10%	750 MW - 10%	750 MW 15%	750 MW - 20% (low O2, ID Fan put in manual)	750 MW - 20% (ID Fan in Automatic)	750 MW repeat Baseline - low O2	750 MW repeat Baseline - (ID fan in Automatic)
			10/25/06 8:40	10/25/06 10:40	10/25/06 13:45	10/25/06 14:32	10/25/06 15:30	10/25/06 17:09	10/25/06 17:58	10/25/06 19:53	10/25/06 20:30
			10/25/06 9:50	10/25/06 12:29	10/25/06 14:06	10/25/06 14:58	10/25/06 16:36	10/25/06 17:32	10/25/06 19:03	10/25/06 20:13	10/25/06 20:50
Test Measurements											
	Units	**TAG # (Source)**									
TEST DESCRIPTION											
Percent Biodiesel	%		0%	5%	10%	10%	15%	20%	20%	0%	0%
Generator Load (MWnet)	MWnet	P6.V.C002NET	755.55	752.93	754.89	754.04	752.47	754.61	752.80	753.14	752.54
Generator Load (MWG)	MWG	P6.V.A0001	784.63	781.83	783.69	783.76	782.36	783.19	782.80	781.77	782.13
HTR 6N CNDS IN	°F	P6.V.A0626	373.4	373.1	373.3	373.3	373.1	373.2	373.2	373.0	373.1
HTRS 7 EXTR TEMP	°F	P6.V.A0703	668.2	670.4	677.2	672.0	671.0	677.1	670.7	675.1	670.0
HTR # 7S STEAM PRESS	psia	P6.V.A0712	667.1	664.2	663.9	665.6	664.8	663.8	665.5	662.6	664.4
HTR 7S DRN TEMP	°F	P6.V.A0713	496.5	495.9	495.7	496.0	495.9	495.8	496.0	495.7	495.7
HTR # 7S DRAIN FLOW DP	inH2Og	P6.V.A0714	258.1	254.6	262.3	254.0	256.0	250.3	263.2	260.3	263.0
HTR 7S CNDS OUT TEMP	°F	P6.V.A0715	498.5	498.0	497.9	498.2	498.1	498.0	498.1	497.7	497.9
HTR 7N STEAM PRESS	psia	P6.V.A0722	668.1	665.3	664.9	666.5	665.9	664.9	666.5	663.6	665.5
HTR 7 N DRN TEMP	°F	P6.V.A0723	494.9	494.7	494.8	495.0	494.9	494.7	495.0	494.7	494.6
HTR # 7N DRAIN FLOW DP	inH2Og	P6.V.A0724	269.3	265.8	258.6	263.7	269.5	264.3	271.3	258.7	269.1
HTR 7N CNDS OUT TEMP	°F	P6.V.A0725	497.6	497.8	498.0	498.1	497.8	497.8	498.1	497.7	497.7
FW PRESS INLET ORIF	psig	P6.V.A0801	2,095.1	2,094.3	2,154.2	2,180.3	2,199.7	2,210.8	2,220.8	2,210.6	2,208.6
FW TEMP INLT ORIF	°F	P6.V.A0802	495.4	495.3	495.4	495.7	495.5	495.6	495.7	495.3	495.3
FW TEMP INLT ECON	°F	P6.V.A0803	499.6	499.1	499.3	499.5	499.3	499.2	499.2	499.1	499.1
FW PRES INLT ECON	psig	P6.V.A0804	2,318.7	2,307.9	2,310.4	2,316.4	2,312.9	2,310.2	2,314.9	2,308.3	2,312.4
FEEDWATER FLO HI RANGE-A-CFX20	inH2Oa	P6.V.A0810	502.5	498.7	496.4	504.2	501.3	495.3	503.5	494.9	502.3
FEEDWTR FLO HI RANGE-B-FX201	inH2Oa	P6.V.A0811	462.6	458.9	456.4	465.0	463.3	455.8	465.0	456.5	460.7
Fans and Dampers											
FD Fan Amps 61	AMPS	P6.V.A1406	292.0	292.3	283.9	291.2	292.2	284.3	294.6	286.5	293.7
FD Fan Amps 62	AMPS	P6.V.A2406	336.0	338.6	326.1	338.7	339.1	327.7	340.7	329.0	340.1
AD Fan Amps 61	AMPS	P6.V.A1436	(0.4)	(0.4)	(0.7)	(0.6)	(0.4)	(0.4)	(0.6)	(0.5)	(0.7)
AD Fan Amps 62	AMPS	P6.V.A2436	310.0	310.0	310.0	308.0	307.7	310.0	307.6	311.3	308.4
AD 61 Fan Damper	%	P6.V.A1434	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4
AD 62 Fan Damper	%	P6.V.A2434	27.2	27.2	27.2	27.2	27.2	27.2	27.2	27.2	27.2
ID Fan Amps 61	AMPS	P6.V.A1456	451.1	455.9	417.8	470.2	478.6	426.7	485.3	423.7	468.4
ID Fan Amps 62	AMPS	P6.V.A2456	-	-	-	-	-	-	-	-	-
ID Fan Amps 63	AMPS	P6.V.A3456	356.8	359.7	331.1	370.7	376.9	339.2	382.0	337.2	371.8
Tube Metal Temps											
NORTH DIV WALL TUBE TEMPS	°F	AVERAGE	785.5	791.1	785.4	789.1	785.8	785.4	787.4	785.8	792.4
SOUTH DIV WALL TUBE TEMPS	°F	AVERAGE	798.2	807.1	801.1	806.8	802.7	801.8	804.6	799.9	807.8
FSH METAL TEMPS	°F	AVERAGE	968.2	969.3	982.5	972.0	971.1	981.6	969.6	977.7	967.5

B
FUEL ANALYSIS

B.1 Fuel Analysis

Run No.	**40%-PM10-1**	**40%-PM10-3**	**40%-PM10-4**	**40%-PM10-5**	**40%-PM10-6**	
Date	**10/24/06**	**10/24/06**	**10/24/06**	**10/24/06**	**10/24/06**	
Start Time	**8:20**	**10:50**	**13:25**	**15:30**	**17:30**	
Stop Time	**09:30**	**11:58**	**14:32**	**16:39**	**18:41**	**Pure**
Fuel Condition [1]	**Baseload**	**B5**	**B10**	**B15**	**B20**	**Biodiesel**
Ultimate Analysis						
% Hydrogen	10.95	10.86	10.93	10.99	11.02	11.90
% Carbon	87.46	86.84	86.11	85.6	85.15	75.70
% Sulfur	0.28	0.275	0.256	0.239	0.228	<0.05
% Nitrogen	0.16	0.14	0.12	0.11	0.11	<0.10
% Oxygen	1.00	1.76	2.48	3.30	3.72	12.40
Btu/pound	18,470	18,421	18,317	18,274	18,186	17,073
F Factor (Calculated)	9390	9326	9312	9283	9285	8989
Na - Sodium Total (mg/kg)	9.0	9.0	8.2	8.2	7.7	<0.50
Ni - Nickel Total (mg/kg)	8.4	8.3	8.0	7.4	7.3	<0.10
Chlorine (mg/kg)	284	257	124	109	86.7	198
API Gravity @ 60ºF	13.7	14.5	15.1	15.8	16.5	28.2
Ash, %	0.08	0.07	0.07	0.06	0.06	<0.05
BTU/Gal	150,100	148,820	147,400	146,380	145,010	126,080
Compability	1	1	1	1	1	1
Flash Point, ºF	> 230	> 230	> 230	> 230	> 230	>230
Micro Carbon Residue	7.845	6.432	5.718	6.529	6.577	0.231
Pour Point, ºF	42	48	48	50	53	22
Viscosity, SSF @ 122ºF	109	72.7	50.6	37.2	29.2	9.2
Viscosity, SSU @ 100ºF	2188	1458	1012	670	467	129
Water % (by volume)	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	<0.01
Water & Sed. % (by volume)	0.10	0.10	0.15	0.10	0.20	<0.025
Btu/lb, LHV	17,471	17,430	17,320	17,271	17,181	15,987

B.2 Full Load Fuel Analysis

Run No.	**1**	**3**	**4B**	**5**	**6B**
Date	**10/25/06**	**10/25/06**	**10/25/06**	**10/25/06**	**10/25/06**
Start Time	**8:39**	**10:40**	**14:32**	**15:30**	**17:58**
Stop Time	**09:48**	**12:29**	**14:52**	**16:30**	**18:58**
Fuel Condition [1]	Baseload	B5	B10	B15	B20
Ultimate Analysis					
% Hydrogen	10.87	10.84	10.91	10.92	11.08
% Carbon	87.51	87.42	86.21	85.60	85.02
% Sulfur	0.283	0.27	0.261	0.238	0.222
% Nitrogen	0.18	0.13	0.14	0.14	0.09
% Oxygen	1.03	1.61	2.74	3.34	3.81
Btu/pound	18,482	18,430	18,406	18,312	18,197
F Factor (Calculated)	9371	9369	9266	9248	9277
Na - Sodium Total (mg/kg)	8.9	8.9	9.1	8.1	7.5
Ni - Nickel Total (mg/kg)	8.4	7.2	7.6	7.2	7.0
Chlorine (mg/kg)	293	163	153	125	80.7
API Gravity @ 60ºF	13.9	14.5	15.1	15.9	16.5
Ash, %	0.07	0.07	0.06	0.06	0.06
BTU/Gal	150,000	148,890	148,110	146,590	145,010
Compability	1	1	1	1	1
Flash Point, ºF	> 230	> 230	> 230	> 230	> 230
Micro Carbon Residue	6.517	6.161	6.508	6.468	6.664
Pour Point, ºF	38	46	44	52	54
Viscosity, SSF @ 122ºF	98.8	72.7	51.4	38.1	28.2
Viscosity, SSU @ 100ºF	1976	1454	1028	762	451
Water % (by volume)	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Water & Sed. % (by volume)	0.15	0.15	0.10	0.15	0.10
BTU/Lb, LHV	17,504	17,441	17,411	17,316	17,186

Baseload fuel was 100% No. 6 fuel oil. Subsequent tests were conducted with fuel containing a percentage of biodiesel as indicated. For example Fuel Condition B5 was conducted with 5% biodiesel.

C
APPENDIX C

TABLE 1
40% LOAD BIODIESEL DEMONSTRATION - EMISSIONS TEST SUMMARY
NYPA - POLETTI STATION

Run No.	**40%-PM10-1**	**40%-PM10-3**	**40%-PM10-4**	**40%-PM10-5**	**40%-PM10-6**
Date	**10/24/06**	**10/24/06**	**10/24/06**	**10/24/06**	**10/24/06**
Start Time	**8:20**	**10:50**	**13:25**	**15:30**	**17:30**
Stop Time	**09:30**	**11:58**	**14:32**	**16:39**	**18:41**
Fuel Condition	**Baseline**	**B5**	**B10**	**B15**	**B20**
Moisture, %	6.7	7.5	8.0	8.2	8.7
CO2 at Stack, % dry	10.28	10.31	10.42	10.37	10.39
O2 at Stack, % dry	7.49	7.45	7.29	7.28	7.34
Dry Molecular Weight, lb/lb mole	29.94	29.95	29.96	29.95	29.96
Wet Molecular Weight, lb/lb mole	29.15	29.05	29.01	28.97	28.92
Excess Air at Stack, %	52.7	52.2	50.5	50.4	51.0
Stack Area, sq. in.	24,329	24,329	24,329	24,329	24,329
Static Pressure, in. w.c.	-0.42	-1.05	-0.97	-0.98	-0.98
Avg. Stack Temp., F	245	245	253	252	254
Stack Gas Velocity, afpm	4,149	4,698	4,168	4,152	4,192
Stack Flowrate, wet acfm	700,897	793,679	704,117	701,495	708,290
Stack Flowrate, dry scfm	490,835	549,872	480,471	478,258	478,727
Method 201A Isokinetics, %	80	94	86	88	87
F-Factor (dscf/MMBtu)	9390	9326	9312	9283	9285
Particulate Emissions - EPA Methods 201A/202					
Emission Rate, lb/MMBtu	0.021	0.014	0.016	0.022	0.034
Emission Rate, lb/hour	43.0	32.3	31.3	43.8	67.5
Stack Gas Viscocity	212	na	213	213	213
Sample Flow Rate, acfm	0.57	na	0.61	0.62	0.62
Cut Point, microns	9.99	na	9.51	9.39	9.39
NOx Emissions - EPA Method 7E					
Concentration, (ppm, dry)	98.0	97.4	91.0	90.5	88.9
Conc., (ppm, dry @3%O2)	131	130	120	119	117
Emission Rate, lb/MMBtu	0.171	0.168	0.155	0.154	0.152
Emission Rate, lb/hour	344	383	313	310	304
CO Emissions - EPA Method 10					
Concentration, (ppm, dry)	1.3	1.5	6.2	6.4	6.4
Conc., (ppm, dry @3%O2)	1.7	2.0	8.2	8.4	8.5
Emission Rate, lb/MMBtu	0.001	0.002	0.006	0.007	0.007
Emission Rate, lb/hour	2.71	3.59	13.05	13.36	13.41
SO_2 Emissions - EPA Method 6C					
Concentration, (ppm, dry)	118	117	114	108	103
Conc., (ppm, dry @3%O2)	157	155	150	142	136
Emission Rate, lb/MMBtu	0.285	0.281	0.270	0.255	0.244
Emission Rate, lb/hour	574	639	545	514	490
Oxygen Concentrations (%-dry)					
Air Heater Inlet - North	7.2	6.9	6.8	6.8	6.5
Air Heater Inlet - South	5.9	6.2	6.0	6.2	6.1
Windbox - North	19.0	19.0	18.9	19.0	18.9
Windbox - South	19.0	19.0	18.9	19.0	18.9
Furnace Exit Temperature, ^oF	1500	1477	1488	1451	1477

TABLE 3
90% LOAD BIODIESEL DEMONSTRATION - EMISSIONS TEST SUMMARY
NYPA - POLETTI STATION

Run No.	**1**	**3**	**4A**	**4B**	**5**	**6A**	**6B**	**7A**	**7B**
Date	**10/25/06**	**10/25/06**	**10/25/06**	**10/25/06**	**10/25/06**	**10/25/06**	**10/25/06**	**10/25/06**	**10/25/06**
Start Time	**8:39**	**10:40**	**13:45**	**14:32**	**15:30**	**17:09**	**17:58**	**19:53**	**20:35**
Stop Time	**09:48**	**12:29**	**16:06**	**14:52**	**16:30**	**17:29**	**18:58**	**20:13**	**20:50**
Fuel Condition	**Baseline**	**B5**	**B10-low O2**	**B10**	**B15**	**B20-low O2**	**B20**	**Base-low O2**	**Baseline**
Moisture, %	7.3	8.5			8.3		8.2		
CO2 at Stack, % dry	12.5	12.3	12.7	12.3	12.1	12.7	12.1	12.7	12.2
O2 at Stack, % dry	4.71	4.93	4.22	4.89	5.00	4.36	5.12	4.44	4.94
Dry Molecular Weight, lb/lb mole	30.18	30.16	30.20	30.16	30.14	30.20	30.15	30.21	30.16
Wet Molecular Weight, lb/lb mole	29.29	29.12			29.13	18.00	29.15		
Excess Air at Stack, %	27.5	29.1	23.8	28.8	29.6	24.8	30.6	25.5	29.2
Stack Area, sq. in.	24,329	24,329	24,329	24,329	24,329	24,329	24,329	24,329	24,329
Static Pressure, in. of H2O	-2.00	-1.40			-1.40		-1.50		
Avg. Stack Temp., F	300	300			304		305		
Stack Gas Velocity, afpm	6,847	6,863			6,912		6,920		
Stack Flowrate, wet acfm	1,156,738	1,159,533			1,167,768		1,169,188		
Stack Flowrate, dry scfm	746,003	738,696			741,255		743,241		
Method 201A Isokinetics, %	98.0	99.8			97.8		97.9		
F-Factor	9371	9369	9311	9311	9248	9277	9277	9443	9443
Particulate Emissions - EPA Methods 201A/202									
Emission Rate, lb/MMBtu	0.017	0.016			0.018		0.017		
Emission Rate, lb/hour	64.10	59.54			66.50		61.37		
Stack Gas Viscocity	224	223			225		225		
Sample Flow Rate, acfm	0.65	0.66			0.65		0.65		
Cut Point, microns	9.57	9.43			9.56		9.55		
NOx Emissions - EPA Method 7E									
Concentration, (ppm, dry)	143	151	118	146	147	120	151	129	153
Conc., (ppm, dry @3%O2)	158	169	127	163	165	130	172	140	172
Emission Rate, lb/MMBtu	0.206	0.220	0.165	0.211	0.213	0.167	0.221	0.184	0.226
Emission Rate, lb/hour	760	795			778		804		
CO Emissions - EPA Method 10									
Concentration, (ppm, dry)	119	74	463	63	65	404	42	320	60
Conc., (ppm, dry @3%O2)	131	83	497	70	73	437	48	348	68
Emission Rate, lb/MMBtu	0.104	0.066	0.392	0.056	0.057	0.343	0.037	0.278	0.054
Emission Rate, lb/hour	385	238			208		136		
SO_2 Emissions - EPA Method 6C									
Concentration, (ppm, dry)	155	145	146	137	131	131	123	157	153
Conc., (ppm, dry @3%O2)	172	163	156	154	147	142	139	171	172
Emission Rate, lb/MMBtu	0.311	0.295	0.282	0.277	0.264	0.255	0.250	0.312	0.314
Emission Rate, lb/hour	1151	1067			965		907		
Oxygen Concentrations (%-dry)									
Air Heater Inlet - North	4.2	4.3	3.7	4.6	4.5	4.2	4.8	no data	no data
Air Heater Inlet - South	2.9	3.1	3.0	3.3	3.4	no data	3.3	no data	no data
Windbox - North	18.9	18.9	no data	18.9	18.9	18.8	19	no data	no data
Windbox - South	18.8	18.9	no data	18.9	18.8	18.7	18.9	no data	no data
Furnace Exit Temperature, ^oF	2055	2030	2064	no data	2043	no data	2025	no data	no data

Run 3 - Start at 10:40, stop test at 11:16 (change in process at 11:10) restart test at 12:06 and stop test at 12:29
Run 4A (performed abbreviated 20 minute gaseous emissions test) no PM10 was conducted per clients instructions (Tests conducted at lower O2 setting)
Run 4B (performed abbreviated 20 minute gaseous emissions test) no PM10 was conducted per clients instructions (Tests conducted at normal O2)
Run 6A (performed abbreviated 20 minute gaseous emissions test) no PM10 was conducted per clients instructions (Tests conducted at lower O2 setting)

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